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ABSTRACT

This cooperative extension publication from Cornell University is a guide for energy conservation in homes, apartments, and transportation. Written in non-technical language, this guide provides the layperson with information about weatherization, home appliance use, recreation and transportation practices to conserve energy and, thus, save money. The major sections of the publication focus on home heating and cooling, energy efficiency and home appliances. Other sections involve home furnishing, clothing, landscaping, home remodeling, home buying, and commuting to save energy. A section on attitudes and education is also included along with some energy conservation activities. An energy management checklist is provided. Tables include: (1) Types of storm windows and doors; (2) Insulation materials, R-valves and uses; (3) Minimum R-valves for homes in areas with annual heating degree days greater than 4500; (4) Characteristics of Northeastern U.S. woods for fireplace use; and (5) Estimated annual kilowatthour consumption for selected electric appliances (1970). Although written for the Northeastern part of the United States, this publication can be useful to energy educators, homeowners, and organizations nationwide. (MR)

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Efficient energy management for consumers from Cooperative Extension New York State

SE 005 041

AN EXTENSION PUBLICATION OF THE NEW YORK STATE COLLEGE OF HUMAN ECOLOGY AND THE NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES, STATUTORY COLLEGES OF THE STATE UNIVERSITY, AT CORNELL UNIVERSITY, ITHACA, NEW YORK

INFORMATION BULLETIN 125

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Introduction

Too much. Too fast. Too wasteful. Too complacent. That's how we are using energy, and we are just now beginning to pay the price. In a few instances, we have already been forced to reduce our consumption by gasoline shortages, severe weather, a blackout, and a few brownouts, especially in the Northeast. However, the extent to which we are willing to give up using energy, either mandatorily or voluntarily, is obviously limited.

Too many unfortunate circumstances have occurred to almost entirely wipe out any interest in conservation or any belief that there is an energy problem at all. For example, in several areas consumers were pleaded with to conserve, and what was the result? Suppliers had to raise prices because the public was using less. There seems to be plenty of gasoline now that the price has increased substantially. It is no wonder that many people do not yet believe that there is a problem.

Regardless of what it may seem, we do have a serious problem, and the longer we wait to confront it, the more critical it becomes. Since the 1973 Arab oil embargo, we have steadily increased our imports from the 36 percent level. Imagine what effect an embargo would have on our country now? The more we depend on Middle East oil, the more we are at the mercy of the OPEC cartel in the price we pay. If we import over 50 percent of our oil and OPEC raises prices at will, we can obviously expect gasoline and other fuel costs to spiral to us consumers.

Why Conserve?

Using our energy more efficiently and with as little waste possible can help us immediately. But more important, conservation can save us money now and year after year. Just adding insulation to a poorly insulated home and sealing air leaks can save at least half the annual heating cost. There are many do-it-yourself activities to help you save energy, and save money. These ideas are explained simply in this manual and should be an encouragement to gain your participation.

Energy Usage

Approximately 20 percent of the energy used in the United States is for residential purposes, and 25 percent, for transportation. The use of energy for transportation and in homes accounts for very nearly 50 percent of our total national consumption; by reducing personal energy consumption in these two areas, we can make a very important contribution. Over 75 percent of the energy used in the home goes for space heating and water heating. Therefore, it will pay you the greatest dividends to look first at these two areas of usage and determine how best to save.

Energy Sources

Some energy sources such as oil and gas are dwindling fast. We have ample amounts of coal, but there are many technological problems to solve before it can be mined and burned without damage to the environment. We are simply finding less and less oil and gas in the United States, and that means we must rely more heavily on imports or switch to other sources of energy such as coal, nuclear, solar, and wind. Switching takes time and a great deal of money for research and development.

United States oil production has declined from its 1970 peak and will probably go on dropping until Alaskan production temporarily interrupts the decline. United States natural gas production is declining even more rapidly since production peaked in 1971 and will likely continue to decline for the foreseeable future. With Canada and Venezuela also running out of oil, there are only the Eastern Hemisphere producers and the Arab countries to fill the gap. Nuclear development has been slowed because of environmental and safety concerns, and it seems unlikely that the estimate of 10 percent of our energy from nuclear power by 1985 will be possible. Thus, unless we reduce our growing demand for electric power, shortages are likely to be commonplace in a few years. Much could be said about sources, but suffice it to say that we are in trouble with our current supplies, and new developments seem to be many years away.

Attitudes and Incentives

A few years ago, we were able to establish a concern by almost all Americans to work toward a better environment. Part of the success was due to a gradual change in our attitudes and habits and part from our incentives to have clean air and water for ourselves and our children. The same awareness and concern are needed to help solve the energy problem. We need to acquire an attitude of less waste and more efficient utilization. The incentives are obvious: to save money and to help solve our nation's most pressing problem. Energy cuts across every aspect of our nation: jobs, economy, quality of life, and food production. We need to encourage in each other an energy-conservation attitude.

Get Acquainted with Your Energy Use

Most of us dislike keeping records, but it is often a very good way to save money. First, start by keeping a record of your gasoline use; and as you begin to incorporate ideas to cut down on your usage, it will be easy to calculate how much you save in gasoline and money. You will, for example, be able to see the effect of keeping your automobile tuned for maximum performance.

Next, get acquainted with your house, mobile home, or apartment. Use the manual information under home heating and cooling to determine where your losses are occurring. Look in your attic for insulation, and measure how much is there. Once you become familiar with your home and its energy use, you will be able to determine what things you can do to save the most energy and money. There is an energy management checklist in the back of this manual. Check off each thing you do, and you will soon see a big difference in the energy use and comfort in your home. Then, if you have been keeping records, you will see how much money you save. The cost of energy will continue to increase; but with some conservation efforts on your part, your total cost may not go up at all or, possibly, may decrease substantially.

If you need expert assistance or advice on any particular subject related to energy use, contact your local Cooperative Extension office. The extension staff will be able to help you right on the spot in most instances. If your question requires special attention, extension agents have a staff of experts they can refer to for help in answering your questions.

Heating Degree Days

Changing fuel prices and season-to-season differences in daily temperatures make it difficult to determine just how well your family is doing at energy conservation. The better way is to compare heating degree days.

Space heating accounts for as much as 75 percent of home energy usage in the northeastern part of the United States. To compare residential heating energy consumption, you need accurate measures of how much heat is needed.

Heating degree days (HDD) have been developed as an excellent indicator of space-heating fuel need from month to month and year to year.

Here's how HDD are calculated:

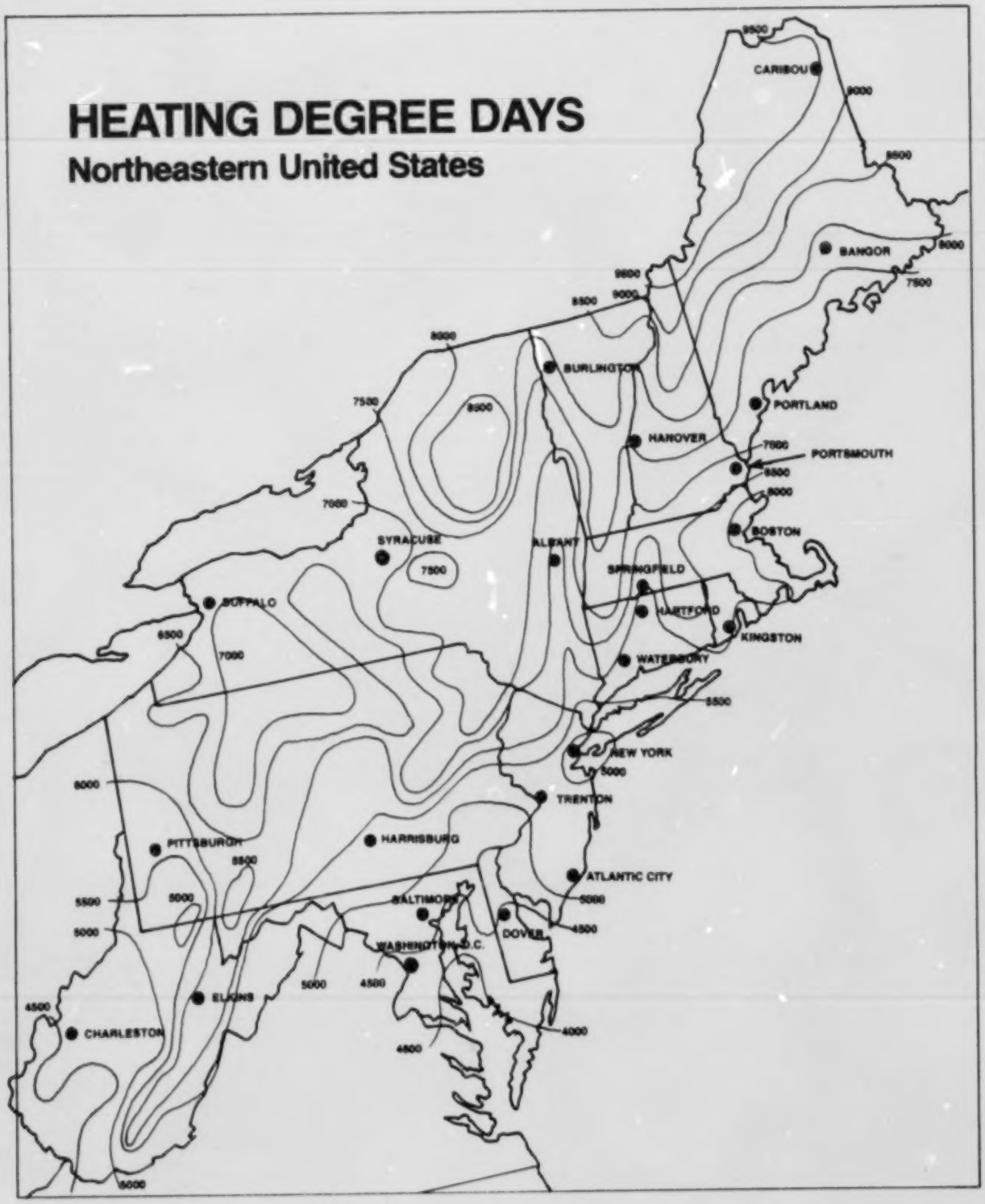
1. In general, heat is not required when the mean [(High + Low)÷2] outdoor temperature is 65°F or above.
2. Heating degree day for a given day is 65°F minus the mean outdoor temperature. For example, on a given day:
   high = 40°F,
   low = 20°F,
   mean = (40 + 20)÷2 = 30°F.
   Thus, heating degree day = 65 − 30 = 35.
3. Total HDD over a period of time are found by adding the results for each day.

Heating degree day information can be obtained from a local newspaper, weather station, oil dealer, or your gas and electric company and can be very helpful in evaluating your own conservation program.

HDD also help to explain variations in energy bills from year to year or month to month. For example:

1. At Ithaca, New York, December 1976 had 1365 HDD, and November 1976 had 969.5. December was thus 41 percent colder than November, and space-heating fuel usage should have been about 41 percent greater.
2. September through December 1976 had 3237.5 HDD, whereas September through December 1975 had 2449 HDD at Ithaca. The 1976 period was thus about 32 percent colder than 1975, and fuel usage would be about 32 percent greater over the same period.

One of the best ways of using the heating degree day measure is to compare fuel usages before and after energy conservation measures are taken. It provides an excellent indication of just how well you are doing.


HEATING DEGREE DAYS
Northeastern United States
CARIBOU
BANGOR
PORTLAND
HANOVER
PORTSMOUTH
BURLINGTON
BOSTON
SYRACUSE
ALBANY
SPRINGFIELD
HARTFORD
KINGSTON
BUFFALO
WATERBURY
NEW YORK
TRENTON
PITTSBURGH
HARRISBURG
ATLANTIC CITY
BALTIMORE
DOVER
WASHINGTON, D.C.
ELKINS
CHARLESTON
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000

1

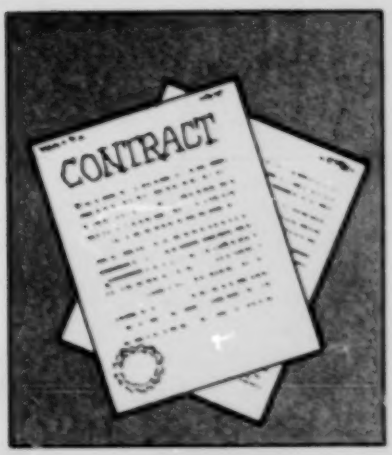
How to choose a contractor

Many of the energy conservation programs described in this manual are do-it-yourself projects. Almost any able-bodied adult can install insulation in an open attic floor or change the oil in an automobile. But it's quite another matter to insulate existing sidewalls or hang a door or tune a car. For these jobs you need special skills and (or) equipment. You can learn basic home maintenance and automobile repair skills from guides and through adult education classes, but at the same time, it is important to acknowledge your own limitations. Inevitably, a job comes along that is too big for you to handle. Then you need a contractor, but how do you go about choosing one?

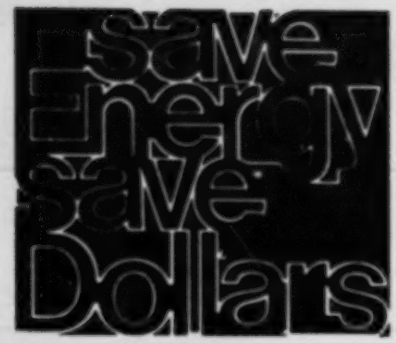
You can start by checking appropriate headings in the classified section of your telephone directory. If friends or neighbors have had work done similar to what you want to do, ask them for the names of the contractors they used and find out if they were satisfied with the person's work. You might also inquire at your local Chamber of Commerce and, if available, at offices for government-funded or nonprofit-operated home-improvement assistance centers.

Assemble a list of three or four contractors. Don't hesitate to consider a one- or two-person operation; size does not necessarily imply quality. Prepare a very specific written description of the work you want done, and

give it to the contractors who are interested in doing the job. Ask each one for a written estimate of your job if you think it will cost more than $200 and for a list of past customers. Check out the references. Call your banker or local credit bureau; ask if the contractors on your list are reliable. Find out how long each contractor has been in business; usually, the longer, the better. After you've followed through on the preliminaries, you should be in a position to decide which contractor you want to hire.



Ask the contractor for a detailed contract for your job. This can best be done if you go by the list you prepared before you looked for someone to do the work. Insist that the contract specify materials, work content, cost, and, if appropriate, warranty. Also obtain a written confirmation of the contractor's liability coverage. Insisting on a detailed contract doesn't mean that you don't trust your contractor; it does mean that you and the person you hire know the limits of responsibility before work begins. Sign the contract only when you are satisfied that everything you want done on the job is included.



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Home heating and cooling

HEATING NEEDS: CONVENIENCE OR WASTE?

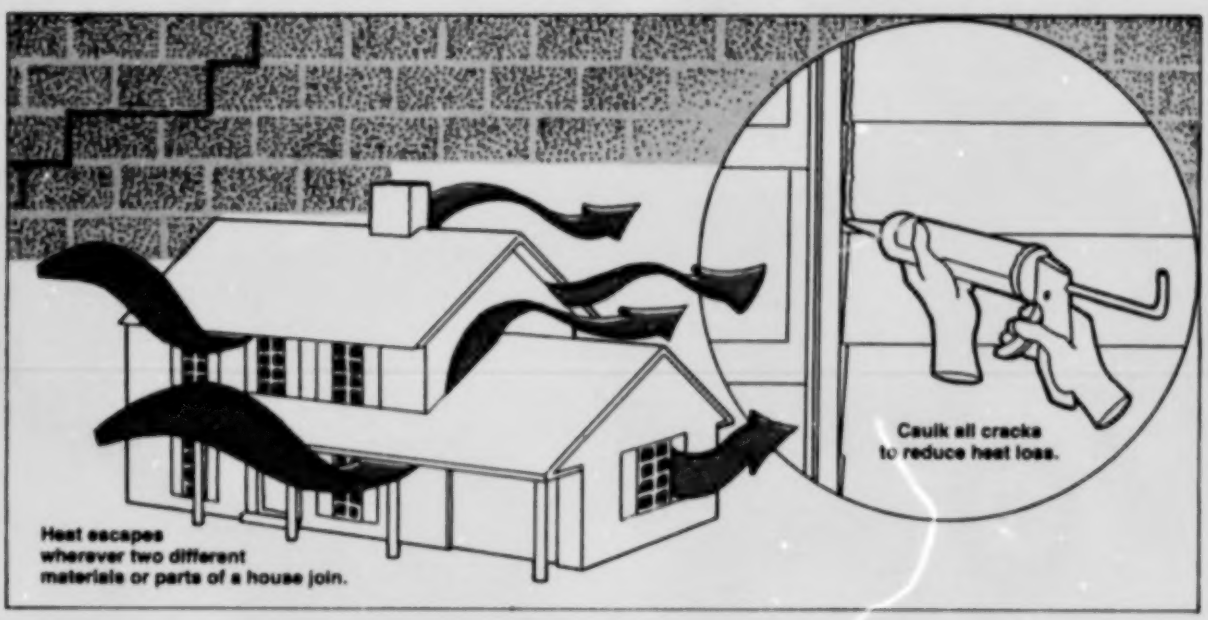
Most people can be comfortable in a dwelling without heat if the outside temperature is above 65°F (18°C).* When the temperature drops below 65°F (18°C), heat is added in the home to satisfy comfort. The time during which heat is required, popularly known as the "heating season," lasts as long as 10 months per year in some parts of the northern regions of the United States.

The usual energy sources used for heating are natural gas, propane, oil, electricity, and, to a lesser extent, coal, wood, and kerosene. Alternative sources utilizing the sun, wind, and water are being developed but it will take time and money to perfect them and make them practicable.

Alternative energy sources are not the subject of this manual. Rather, it is directed toward that majority of homeowners and renters who use gas, oil, or electricity for heat and who, in the face of limited natural and financial resources and spiraling costs, want to save energy and dollars.

Not long ago energy was considered cheap and abundant. Much was wasted, camouflaged as convenience. Now it is known that existing energy supplies are limited, and every person who pays a heating bill knows fuel is no

*The numbers in parentheses ( ) represent the metric equivalent of the English units. Metric equivalents appear throughout the manual.



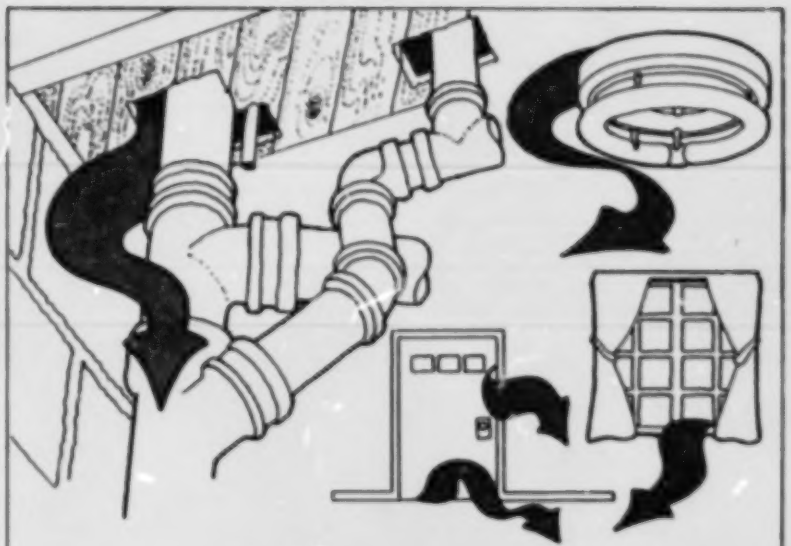
longer cheap. But the waste goes on. This section of **Save Energy, Save Dollars** points out how heating waste can be eliminated and the energy conserved.

Comfort need not be sacrificed, but convenience must be evaluated realistically. For example, it is convenient to have an automatic heating system. If you do not turn back your thermostat before retiring at night, it would be inconvenient to train yourself to do so. But leaving a thermostat at the same setting, day and night, is wasteful. Covering single-pane windows with heavy plastic during the heating season takes time and costs about $60 for a home of 1,400 square feet (130 square meters). That's inconvenient. Not covering windows may increase your fuel bill up to 30 percent. That's sheer waste!

New habits must be learned and corrective steps taken to reduce energy use. Your fuel bill is a recurring expense; the energy-saving measures described in the following sections are, for the most part, one-time expenses, and the money spent will be returned to you in energy and dollars saved. The time to take these steps is now.

HEAT LOSS

Heat tends to migrate from warm to cool areas. Thus, heat escapes and cold air enters wherever two different materials or parts of a dwelling join and through any opening in the exterior of a home. This is heat loss by **convection**. In addition, heat passes from heated to unheated areas of a structure or from heated areas through structural materials to the outdoors. This is heat loss by **conduction.**



Common areas where heat loss occurs inside home

Securing your home against heat losses caused by convection and conduction could reduce your fuel bill as much as 40 percent. A tall order? Not if you are willing to examine your home carefully and make thorough repairs and adjustments.

Remedies for Heat Loss Caused by Convection

Older homes often have many cracks around doors and windows. Masonry exteriors — stone, stucco, and brick — often develop cracks which should be sealed. But old or new, frame or masonry, insulated or not, **all** homes suffer some heat loss through convection. Remedies for this situation — caulking, weather stripping, and sealing — are among the least expensive of energy savers and, in most cases, are do-it-yourself jobs.

Caulking

On the outside of the home, look for cracks in the following places:

- **Around window and door frames, sills, and joints. Also check the putty around window panes and repair if cracked or worn away.**
- **At corners formed by siding.**
- **Between porches and the main body of the dwelling.**
- **Around water faucets, electrical outlets, and gas or oil lines.**
- **Where the chimney or masonry meets the siding.**

On the inside of the home, check:

- **Between foundation and the sill plate.**
- **Around ceiling fixtures.**
- **Around water pipes and drains.**
- **Around the furnace flue, plumbing vents, pipes, and air ducts in the attic.**
- **Between heated and unheated areas, such as attached garages and crawl spaces.**

Caulking compounds are used to seal cracks and are available in cartridges to be used with a caulking gun and in bulk, tube, and rope form. Choose the caulking compound best suited for your job.

Oil or resin base is the least expensive type of caulking compound. It is also the least durable, lasting as little as one year. Although it bonds to most surfaces, a primer must be used if it is applied to a porous surface. Oil or resin-base compounds cannot be applied successfully if the temperature is below 60°F (16°C).

Latex requires a primer if applied to a metal surface. It will last up to 10 years if applied when the temperature is above 40°F (4°C). Latex is an excellent choice for wood and painted surfaces.

Silicone requires a primer if applied over a bonding agent or over a previously glued crack. It will last up to 20 years and can be applied in below-freezing temperatures. Silicone is excellent for use on wood, metal, and painted surfaces; its adhesion to masonry is slightly less effective.

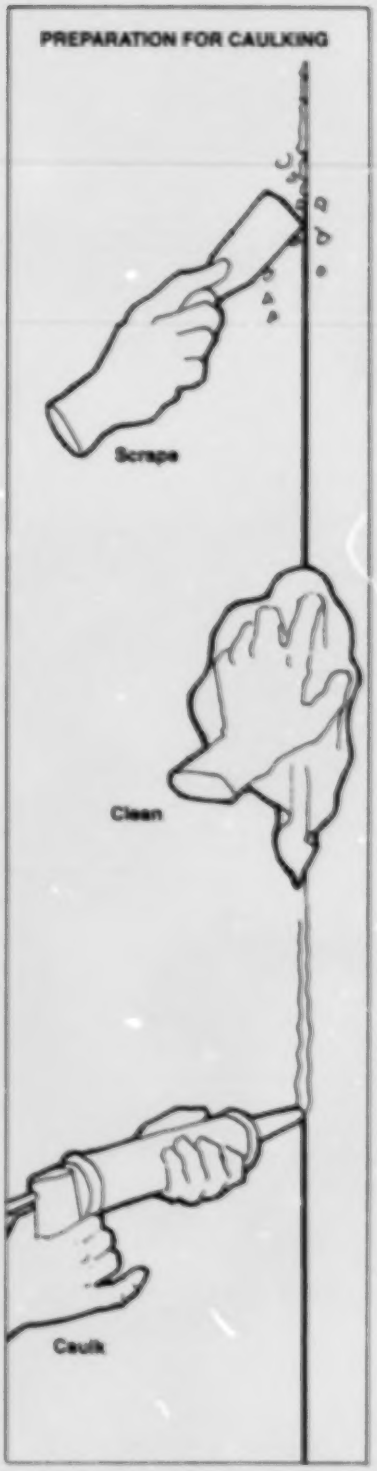
Butyl requires no primer and is very durable, lasting up to 20 years. A butyl compound must be applied when the temperature is above 40°F (4°C). It is an excellent choice for unpainted wood, metal, and masonry surfaces.

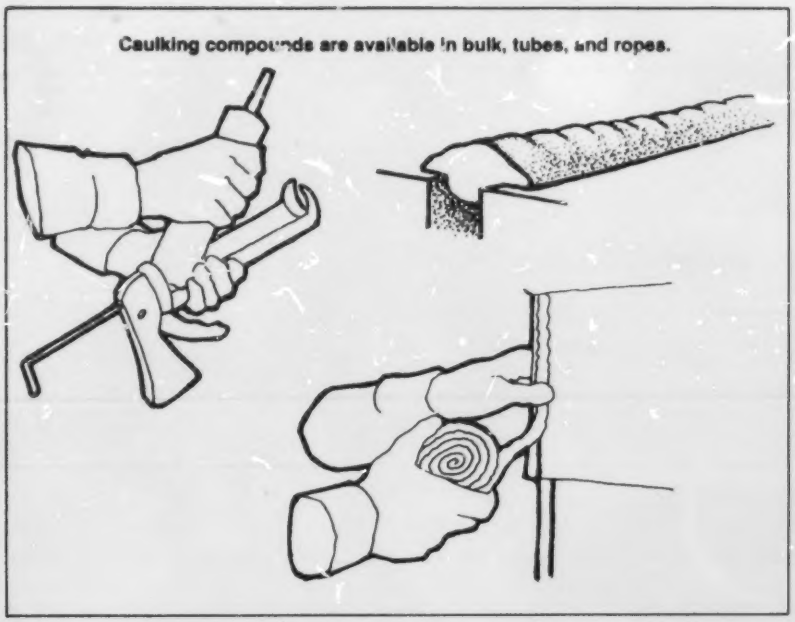
Do not use lead-base caulking compounds; they are toxic.

With a little practice, the application of caulking material is fairly easy; but because a thorough job takes time, spending a little extra money for a durable compound is worth your while.

If you have any doubts, consult a reputable hardware or building materials supplier about the type of caulking compound required for your particular job.

Common areas of heat loss outside the home





Caulking compounds are available in bulk, tubes, and ropes.

How to apply caulking compound

Thoroughly clean the area to be caulked with a solvent and putty knife. Get rid of dirt, built-up paint and cracked putty or old caulking compound. If cracks are deep or wide, fill them with caulking cotton, sponge rubber, or mineral wool before applying caulking compound.

A caulking gun is useful for long, narrow cracks. Hold the gun at a 45° angle and work from top to bottom. Make sure the bead covers both sides of the crack. It may be necessary to apply a second bead if the crack is wide. Seal the two beads.

A warning: Don't caulk windows or doors so that they cannot be opened in case of emergency.

Weather Stripping

Weather-stripping material is used to seal air leaks around windows, doors, and all movable joints in a home. It is available in felt, foam rubber, flexible vinyl, and metal strips and can be purchased by the running foot (meter) or in packages that contain enough material and tacks to weather-strip an average size, double-hung window or a door.

Install weather stripping:

- **Around loose-fitting window sash and casings.**
- **Around loose-fitting entrance doors.**
- **Around doors or any openings between heated and unheated spaces. Don't overlook the opening to your attic!**

Weather-stripping materials and installation

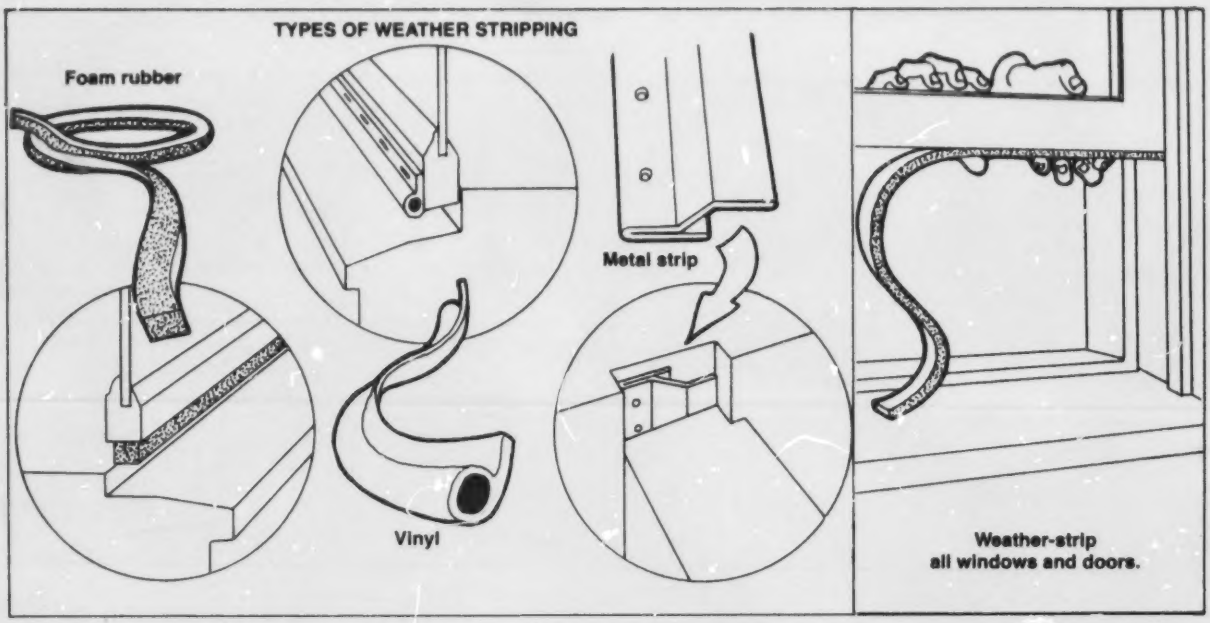
Felt and foam-rubber weather stripping — the latter sold with an adhesive or wood backing — are inexpensive and easy to install; however, they are not very durable and are apt to shrink over time. Felt and foam rubber should not be used where friction occurs. These materials are more effective on the inside of door jambs than on windows.

Flexible vinyl is sold with metal backing for use on doors and without backing material for use on windows. Although visible when installed, it is easy to use and is durable. Strips are tacked around the outside of a window and on the top and bottom rails so that the roll compresses when the window is closed. Install metal-backed vinyl strips along the center of the sides and top of a door jamb.

Spring-metal weather stripping is the most durable material and is available in various widths. Installation may be difficult on old windows, especially if the casings and sash have been painted several times. (If that is your situation, rolled vinyl is a better choice.) Attach metal weather stripping between the sashes and the channels of a window — leaving the pulleys in the upper channel uncovered — and along the full width of the rails. Another strip should be tacked to the inside of the upper sash's bottom rail. Bend back exposed ends so that they will not catch on the sash. Install spring-metal weather stripping along the inside of the top and sides of a door casing.

Do not tack weather-stripping material on the sash **and** the frame or to the upper **and** lower sashes. Tacks should be placed on one side only so that a window can be opened in case of emergency.

To determine the amount of weather stripping needed,



measure the total distance around the movable parts of a window and the top and sides of a door. Allow a few extra inches (centimeters) for waste.

Door sweeps

Door sweeps are used to reduce air infiltration at the bottom of doors. They are usually vinyl- or felt-backed metal strips and are sold by the running foot (meter). Cut the strip to within 1/16" (1.5 mm) of the door width and attach to the inside of the door so that the strip just touches the carpeting or floor. Gauge this carefully as a sweep placed too low on an inward-opening door will drag against carpeting or scrape the floor.

Additional ways to reduce air infiltration

Energy-wise homeowners can reduce air infiltration even further by sealing or closing "heat wasters."

- **Repair loose door latches and tape unused keyholes.**
- **Keep exterior doors tightly closed, as well as doors leading to the attic, basement, and attached garage. And don't open them unnecessarily!**
- **Close off infrequently used entrances and consider adding vestibules at those commonly used.**
- **When a fireplace is not in use, close the damper securely.**
- **Cap *unused* flues or chimneys.**
- **Close off unused rooms, especially those on northern or windy sides of a dwelling, and reduce the temperature in these areas.**
- **Keep the overhead doors of an attached garage closed.**
- **If zone heating is used, close doors between areas with different thermostat settings or install doors if there are none.**
- **If you sleep with a window open during the winter months, weather-strip and close the bedroom door so that heat from the rest of the home will not be lost.**

Remedies for Heat Loss Caused by Conduction

Heat is lost by conduction through windows, doors, walls, floors, ceilings, roofs, and through any unheated area of a structure. There are two things a homeowner can do to reduce heat loss by conduction: install storm windows and storm doors, and add thermal insulation.

Storm windows and storm doors

Windows and doors cover about 20 percent of the sidewalls in an average home. Heat loss through and around windows and doors may be responsible for as much as 30 percent of your fuel bill.

Storm windows and doors cut heat loss caused by convection and conduction by creating dead air space between exterior and interior windows and doors. This air space — it should be at least ¾" (2 cm) — is the actual energy saver. Where severe winters are common, heating costs can be reduced 10–30 percent by installing tight-fitting storm windows and storm doors. Cover all windows and entries to heated areas of the home.

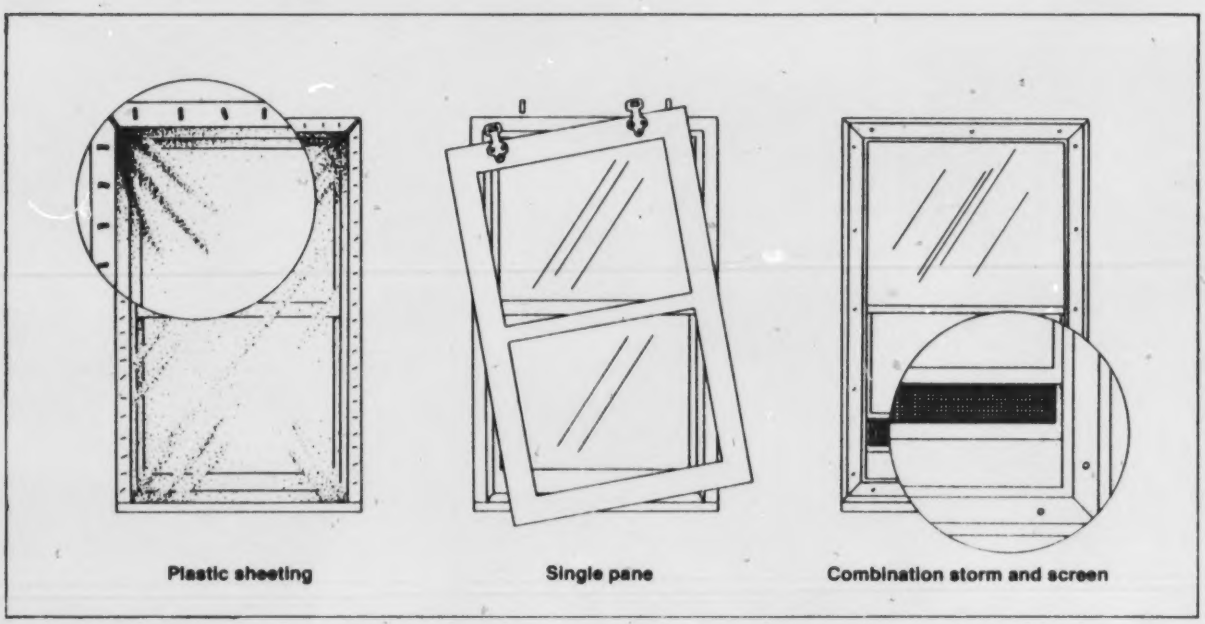
There are three basic types of storm windows and doors: plastic sheeting, single-pane glass or rigid plastic, and combination screen and storm (triple-track combination). To be worthwhile, all must be installed with weather stripping or gaskets along the crack between the storm unit and the window or door frame.

Plastic sheeting of at least 6-mil thickness can be cut slightly larger than the area to be covered and attached to a window or door with pressure-sensitive or masking tape or, preferably, ¼" (6 mm) wood slats. Damage from ice and wind can be avoided if the plastic is mounted on the inside of the window. Usually, the installation of plastic storm sash is a do-it-yourself job. It is economical and efficient for renters and homeowners. If used on the outside of the window, new plastic should be installed each year; if used on the inside, several years' use from the plastic may be possible.

Plastic sheeting has to be cut or slashed if an emergency escape is necessary.

Single-pane storm windows and storm doors of glass or rigid plastic are usually stored during the summer and put on each winter. Check seasonally and replace cracked putty. Paint regularly to preserve the frames if they are made of wood. Anodized aluminum frames are virtually maintenance-free.

An experienced contractor is the usual source for single-pane storm windows and doors (see "How to Choose a Contractor," page 7). If you are skilled in carpentry, you can make them. Windows and doors are not projects for the beginning do-it-yourselfer. A



Plastic sheeting | Single pane | Combination storm and screen

thorough window insulation job with plastic sheeting and weather stripping is more effective than an ill-fitting, single-pane storm sash.

If an emergency escape is necessary, single-pane storm windows must be broken.

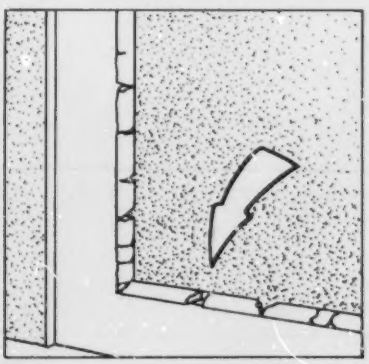
Combination screen and storm windows and doors remain permanently in place. Self-storing screens are incorporated into the units; therefore, screens and storms can be interchanged easily. Combination units are designed for installation over double-hung windows and are available in steel and in plain- and baked-aluminum finishes. The baked-aluminum finish requires the least maintenance and is the most durable. Properly fitted combination units have ¼" (6 mm) vents in the frame where the storm sash meets the sill. These vents keep condensation from collecting and causing rot, and should always be kept clear. If your present combination units do not have such vents, you should drill them through storm window frames.

The construction and, usually, installation of combination storm windows and doors are jobs for an experienced, reputable contractor. (See "How to Choose a Contractor," page 7.) It is possible to save 10–15 percent of the purchase price of combination units if you install them yourself. Whether you have a contractor install the units or do the job yourself, on the day of installation, check to be sure that window and screen sashes slide easily in their sash track (the metal grooves in which the windows and screens move up and down) and that they seal well when closed. In addition, there should be a tightly caulked seal between the frame of the storm window and the window frame of the dwelling.

The marketplace abounds with combination units of varying quality and cost; check out several before you buy. Hardware — locks, catches, guides — is a good indicator of overall construction quality of combination units. In addition, good combination units have overlapped rather than mitered joints, have reasonably deep sash tracks, and are fully weather-stripped with durable material. For safety's sake, insist on safety glass or rigid plastic for storm doors.

Table 1 compares the three basic types of storm windows and doors.

An annual maintenance check of all windows should be made, regardless of the type of storm windows and doors you use. Worn or cracked putty around the glass should be repaired. Air inflow around windows reduces the effectiveness of the storm sash.



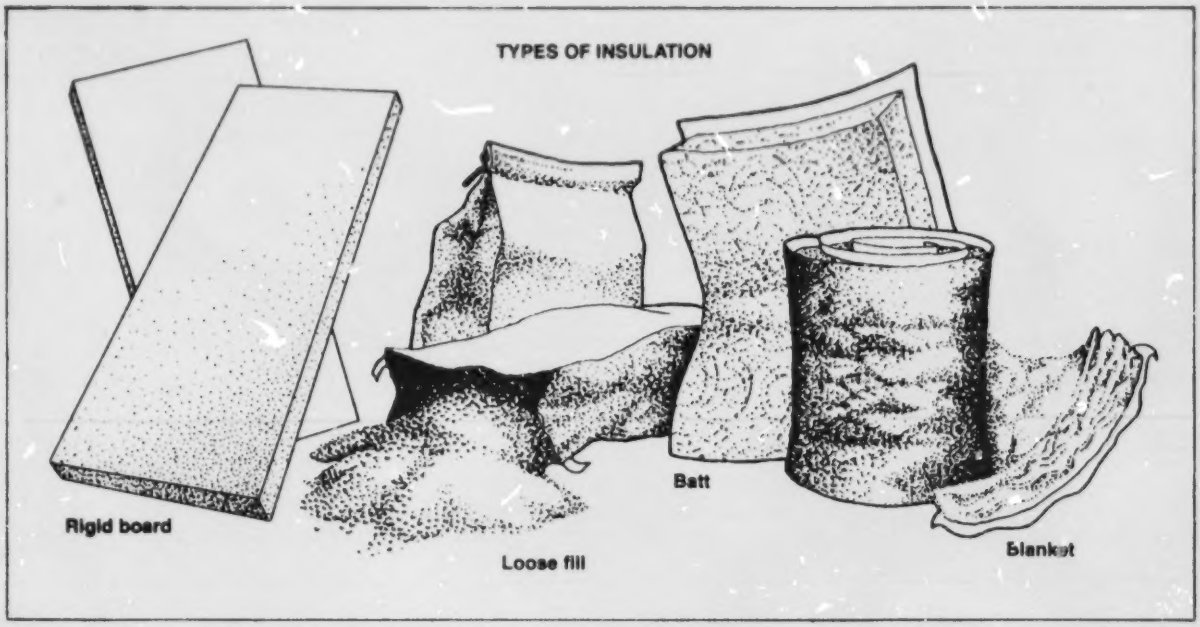
Financing and long-term savings

Storm windows and doors conserve energy as well as add value to a residence. You may wish to finance the installation of storm windows and doors with a home improvement loan, currently available for up to 5 years from commercial banks. FHA/HUD Title I Loans are available in some areas for up to 12 years through savings and loan associations, savings banks, and some credit unions. The maximum amount available to a borrower is $10,000 under an FHA/HUD Title I loan; lenders cannot charge any fees for such loans. Obtain estimates from contractors before visiting a bank to make application for a loan.

It is estimated that storm windows and doors will pay for themselves in 7 years or less, depending on energy costs, with 12 percent interest charges. After that, they will return a dividend of 13–18 percent. A smart way to save energy and dollars!

Table 1. Types of storm windows and doors

	Plastic sheeting	Single pane/ rigid plastic	Combination
Initial cost	Low	Medium	High
Durability	Low	Medium-high	High
Maintenance–time	High	High	Low
Maintenance–cost	Medium	Medium	Low
Visibility	Low-medium	High	High
Ease of opening	Low	Low	High
Ease of installation	Low	Medium	Medium



INSULATION

Any material that reduces the passage of heat through the walls, ceilings, floor, or roof of a building is insulation. Thermal insulation is any one of a variety of materials designed and installed in a structure for the sole purpose of reducing heat conduction. It does not heat or cool. Because thermal insulation forms a protective blanket around the living area of a home, it is needed around all areas heated in winter and cooled in summer. Fuel supplies are limited and expensive; so properly selected and correctly installed thermal insulation is one of the best energy-saving investments a homeowner can make. It is a one-time investment and pays dividends in the form of reduced fuel bills.

Insulation R-values

A good thermal insulating material is dry, fire resistant, economical, easy to install, and, most important, contains many small pockets to trap air and resist heat conduction. The resistance of insulation to heat passing through it determines its effectiveness or its resistance value (R-value).

The higher the R-value, the more effective the insulating material. For example, 1" (2.5 cm) of dense glass-fiber insulating material has an R-value equal to about 40" (100 cm) of concrete. Therefore, when purchasing insulating material, always buy according to the R-value, not by thickness. Industry standards require that R-values be printed clearly on insulation wrappers or containers.

Insulation materials

There are four basic types of thermal insulation: flexible, loose fill, rigid, and foamed-in-place.

Flexible materials include glass-fiber and mineral-wool batts and blankets from 1"–9" (2.5 cm–23 cm) thick. Batts are usually 4' (1.2 m) long; blankets come in long rolls and are cut to length by the installer. Batts and blankets are commonly available in 15" (38 cm) and 23" (58 cm) widths to fit standard wood framing. They are sold with or without a kraft paper or foil vapor barrier. Both are flame and moisture resistant and are easy to install. Batts and blankets are used for insulating unfinished attic floors and rafters, the underside of floors, crawl spaces, and open walls.

Loose-fill insulating materials are available in glass fiber, mineral wool, cellulose fiber, and vermiculite. Loose fill is sold by the bag or bale. A vapor barrier should be added to keep the insulating materials dry. (See "Vapor Barriers," page 19.) Loose fill can be poured between the joists in unfinished attic floors by the homeowner. It can be blown into an attic space or wall cavity by a contractor or by the homeowner with rented equipment. Loose fill is good to use above flat ceilings if joist spaces are irregular or

obstructed. Follow the manufacturer's instructions for the amount required to meet the desired R-value. Loose-fill glass fiber and mineral wool are fire resistant. If installed with a vapor barrier, moisture should not be a problem.

Cellulose fiber is fire and vermin resistant, but it is not moisture resistant. High attic temperatures may vaporize fire-retardant chemicals. Cellulose fiber has about 20 percent higher resistance to heat and conduction than glass fiber or mineral wool. This is an important factor if space for insulation is limited. If a contractor installs the material, the homeowner should calculate carefully the amount of loose fill required per square foot (meter) of area to be insulated and then keep track of the amount used by the contractor. Ask to see the empty bags or containers.

Vermiculite has an R-value about 70 percent that of glass fiber or mineral wool and can be poured successfully into small or tight areas. It is commonly used to insulate masonry blocks.

Rigid-board materials are used for the insulation of basement walls, the perimeter insulation of floor slabs, and in new construction. In many cases, rigid-board insulation can be added successfully when siding is added or replaced. A thin sheet of rigid-board insulation offers a high R-value. Extruded polystyrene and urethane need no vapor barrier; bead board and glass fiberboard do. To meet fire code requirements, all types of foamed plastic insulation must be covered with ½" (1.3 cm) gypsum board or its equivalent.

Foamed-in-place insulation includes sprayed-on urethane and urea formaldehyde. Because special equipment and skills are needed, a highly qualified insulation contractor should do the installation. (See "How to Choose a Contractor," page 7.)

Urea-foam insulation is a new technique, and to date, its long-term effectiveness is not known. Urea formaldehyde shrinks 1–3 percent and is considered noncombustible. If urea formaldehyde is foamed into a structure when the outside temperature is below 55°F (13°C), without the proper equipment and

Table 2. Insulation materials, R-values, and uses

Material	R-value* per inch	R-value* (per cm)	Where used
Flexible			
Cellulose fiber with vapor barrier	3.20–4.00†	(1.3–1.6)	Unfinished attic floors, open sidewalls, heating ducts, crawl spaces, underside of floors, rafters
Glass fiber or mineral wool	3.00–3.40†	(1.2–1.3)	
Loose fill			
Glass fiber and mineral wool	2.80–3.40	(1.1–1.3)	Finished and unfinished attic floors, finished frame walls
Cellulose	3.50–3.70	(1.4–1.5)	
Vermiculite, expanded	2.13	(0.84)	
Rigid board			
Polystyrene, extruded	5.26	(2.1)	Basement walls, new construction, floor slab perimeter
Expanded urethane, preformed	5.80–6.25	(2.3–2.5)	
Glass fiberboard	4.00	(1.6)	
Polystyrene, molded beads	3.57	(1.4)	
Foamed-in-place			
Expanded urethane, sprayed	6.25	(2.5)	Finished frame walls, finished and unfinished attics
Urea formaldehyde	5.00§	(2.0)	Finished frame walls

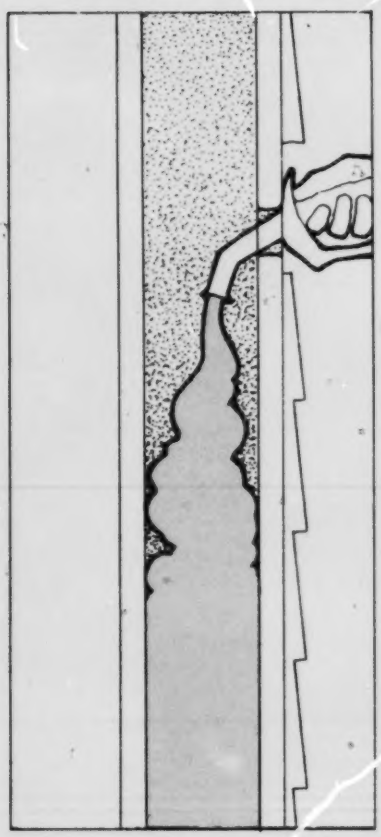
*Determined from ASHRAE Handbook, 1972.
†Varies according to density and fiber diameter.
§From manufacturers' specifications.

precautions, it may not cure properly. Fumes from the material can be temporarily unpleasant.

Sprayed-on urethane is considered combustible and must be covered with a fire-rated finish.

Table 2 (page 17) compares the R-values of the insulation materials described in this section of the manual.

The homeowner planning to install insulation should be familiar with the effects of excess humidity in a home and should take steps to alleviate it. Moisture breaks down insulation, and wet insulation is worse than no insulation at all. Vapor barriers and ventilation restrict and reduce excess moisture; they go hand-in-hand with properly installed insulation.

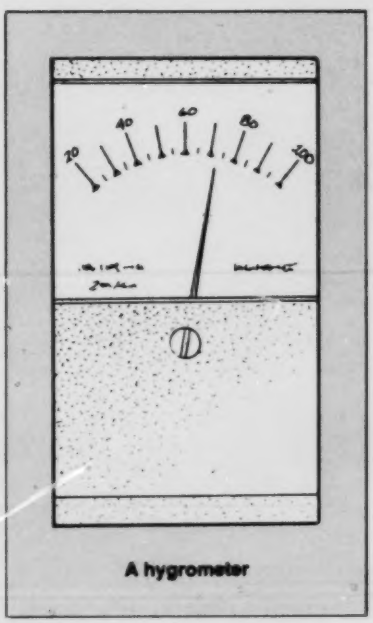


Effects of Humidity

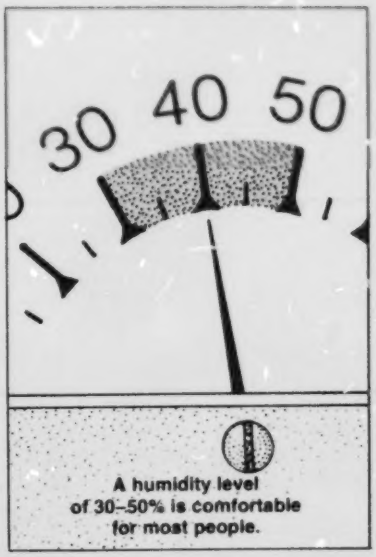
The amount of water vapor in the air — humidity — affects comfort and determines the need for heat. A humidity level of 30–50 percent is comfortable for most people. A lower level may be necessary in some homes to prevent condensation.

In summer, the combination of high temperature and high humidity is uncomfortable. In winter, outside air is cold and holds relatively less moisture. As this air enters the house and then passes through a home heating system, the relative humidity becomes very low. This lower-humidity air increases the rate of evaporation of moisture from the skin and produces a cold sensation, even at fairly warm air temperatures.

Water vapor is commonly added to heated air during the winter — humidification — to aid human comfort and health and to prevent shrinkage of wood furniture. Many articles with tips on energy conservation have suggested that humidification can save energy by permitting a lower air temperature while maintaining thermal comfort. However, in almost all cases, the energy involved in humidification exceeds that saved by the decreased heat loss of a lowered inside temperature.



A hygrometer



A humidity level of 30–50% is comfortable for most people.

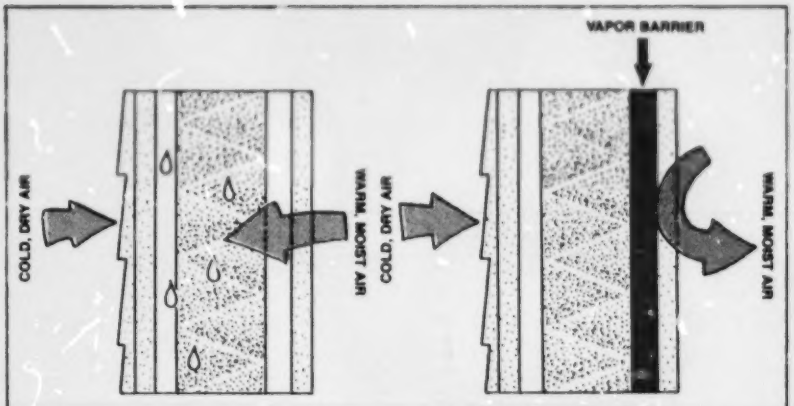
Humidification systems

Water vapor can be added automatically to the hot air flowing from a heating unit if a humidifier is added to a hot air furnace. Installation of a built-in humidifier requires skills in electrical wiring, plumbing, and sheet metal forming. It is usually a job that requires a professional. (See "How to Choose a Contractor," page 7.)

Free-standing humidifiers are readily available and are easy to install. Water is usually added manually each day, although some units can be plumbed for automatic operation. In automatic operation, a device called a humidistat senses and controls the humidity at the desired level. Follow manufacturer's instructions for proper operation and maintenance.

Humidity tips

- **The level of humidity in your home can be measured with a hygrometer, an instrument available at most hardware stores.**
- **Water vapor from cooking and bathing adds moisture; so use exhaust fans sparingly during the heating season. Let excess moisture from the kitchen and bathroom(s) pass into other parts of the home where it is needed.**
- **If an *electric* clothes dryer is used, it can be vented into the home during winter months to add heat and humidity. Install an extra lint trap. Discontinue indoor venting if condensation runs off windows or if a dust problem occurs. Vent outside during the summer months.**
- **Plants not only beautify the home, but also add some water vapor to the air through transpiration and evaporation.**



A vapor barrier protects walls from condensation.

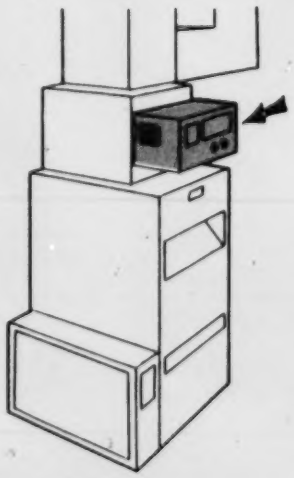
Vapor barriers

Uninsulated, poorly weather-stripped or caulked houses have a high rate of air exchange and require reasonably high levels of humidification to maintain 30–50 percent humidity. On the other hand, houses with good vapor barriers retain humidity.

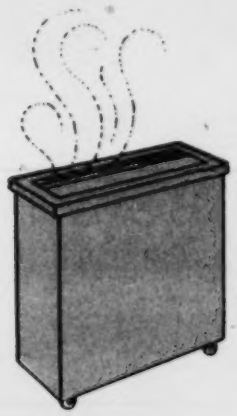
A vapor barrier restricts the passage of moisture through walls and ceilings. Aluminum foil and 4-mil plastic sheeting make effective vapor barriers; kraft paper is less effective. A vapor barrier is **always** placed next to the living area or against the warm side of a wall, ceiling, or floor.

Flexible insulating material is

THREE WAYS TO HUMIDIFY THE AIR



Built-in unit



Freestanding unit

Vaporizer

available with an attached vapor barrier. If unfaced or loose-fill material is used, staple 4-mil plastic film to wall studs after the insulating material is installed or between ceiling joists before the ceiling insulation is put in place.

To be most effective, a vapor barrier must be continuous. Lap and fold plastic film at splices and joints. Do not cover attic joists with plastic; place strips between joists or trusses. Tape joints and around windows, doors, light fixtures, pipes, and electrical outlets. Patch any tears or holes punched in a vapor barrier during installation.

Do not install a vapor barrier between layers of insulation.

In some cases, such as finished attics or sidewalls, it is not possible to install a vapor barrier when insulating. Then measures should be taken inside the home. Two coats of gloss enamel, alkyd semigloss, or aluminum paint provide a satisfactory vapor barrier on walls or ceilings. This procedure is especially recommended for high-moisture areas such as kitchens, bathrooms, and laundry rooms. A reputable paint dealer can advise you on the selection of vapor-resistant paints.

If wallcovering is preferred, use vinyl, plastic, or foil material. Select a wide-stripped material to reduce the number of seams. First prime the wall with a vapor-resistant sealer or sizing compound.

Whether paint or wallcovering is used, caulk all interior cracks. Check carefully around window and door frames, electrical outlets, pipes, baseboards, and ceiling fixtures. High humidity levels should be avoided.

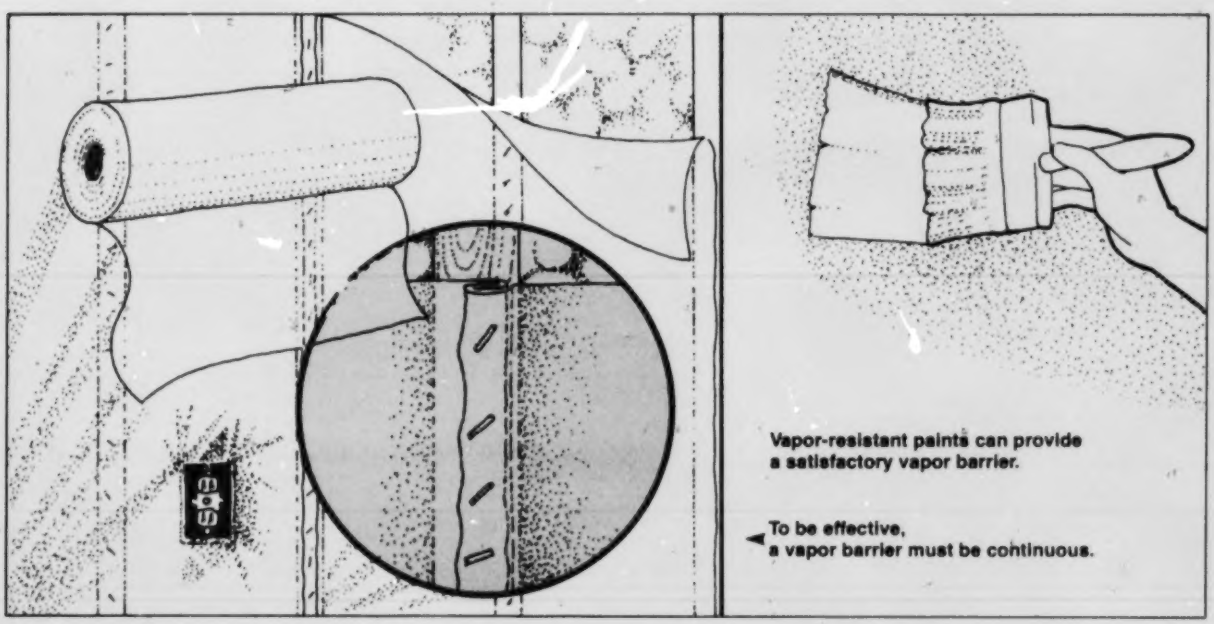
If condensation problems develop after the preceding measures have been taken, vent the top and bottom of each stud cavity with plug inserts. This is done on the exterior of the home. The louvers of the plugs should slope downward so that precipitation will not enter the wall.

An unheated crawl space needs 2 vapor barriers: overhead, before insulation is installed, and across the ground or floor. A sheet of 6-mil plastic can be run across the crawl space floor after insulation is installed. Tuck it under the insulation so that it touches the wall; tape or lap joints. Be sure to patch any holes punched in the vapor barrier during installation.

Ventilation

Ventilation is the changing of air in any space. It uses energy because inside air is replaced with outside air. Ventilation is useful to remove moisture, odors, smoke, heat, and airborne bacteria. Attic and crawl space ventilation is considered here; a discussion of kitchen and bathroom ventilation can be found on pages 44 and 66.

Ventilation louvers are used to promote air circulation. Louvers should be installed in pairs to provide an inlet and outlet to the space being ventilated.



Vapor-resistant paints can provide a satisfactory vapor barrier.

To be effective, a vapor barrier must be continuous.

Attic ventilation

An attic should be vented to remove summer heat and winter moisture. Vent openings should equal 1 square foot (0.09 square meter) for each 300 square feet (28 square meters) of attic floor area (the length times the width). If a structure is air conditioned, or if there is no vapor barrier in the ceiling, the vent openings should equal 1 square foot (0.09 square meter) for each 150 square feet (14 square meters) of attic floor area. If vents are protected by screening or rain louvers, check table 3 for basic opening size.

Table 3. Vent openings for different types of covering

Type of covering	Size of opening
¼" (6 mm) hardware cloth	1 × net vent area
¼" (6 mm) hardware cloth and rain louvers	2 × net vent area
8-mesh screen	1¼ × net vent area
8-mesh screen and rain louvers	2¼ × net vent area
16-mesh screen	2 × net vent area
16-mesh screen and rain louvers	3 × net vent area

SOURCE: Federal Energy Administration.

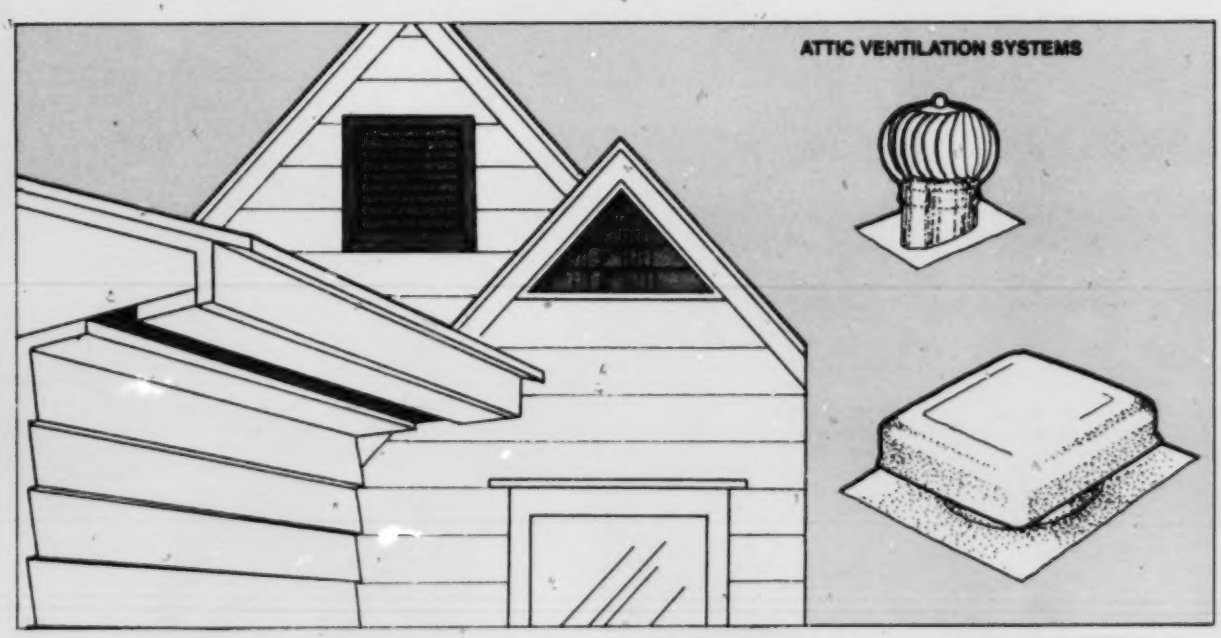
In areas with heavy snowfall, ice dams can form to trap water and cause it to leak into the home. Poorly insulated houses without proper ventilation lose enough heat to melt snow on the roof. The water flows down the roof and refreezes on the cold overhang, forming an ice dam that backs up water. Adequate attic insulation with gable and eave vents will keep the attic cold enough to eliminate most ice dam problems.

Vents in gables and eaves are more efficient than gable vents alone. Unlike motor-driven fans, louvered panels or wind-powered roof ventilators save energy. They are usually sufficient in cooler, northern climates.

The illustrations below show various types of attic vents. Unless you are an experienced carpenter, the installation should be done by a professional. (See "How to Choose a Contractor," page 7.)

Never block vents with insulation.

During the winter, it is advisable



to seal or partially close gable vents on the west or northwest ends of an attic. In some locations, snow may be blown through vent ports and be absorbed by insulation. Keep at least one gable vent open during the winter. Seldom will snow be blown in eave vents.

Crawl space ventilation

During the summer, unpaved crawl spaces need ventilation to remove musty air. If there is a proper vapor barrier, crawl space vents should equal 1 square foot (0.09 square meter) for each 1,500 square feet (140 square meters) of floor area (the length times the width). If there is no vapor barrier, vent openings should equal 1 square foot (0.09 square meter) for each 150 square feet (14 square meters) of area to be ventilated. There should be at least two vents, located opposite one another, for cross ventilation. Check table 3 for basic opening size if vents are protected by screening.

Unless your furnace draws its combustion air from the crawl space, vents should be blocked and tightly sealed in winter and opened in summer. Consult a heating contractor about ventilation if the crawl space is the source of combustion air for your furnace.

If air from your furnace passes through a crawl space, seal and block vents in winter and open them in summer. The air from the furnace provides sufficient winter ventilation. If there are no vent openings in a crawl space, and if air from your furnace passes through it, run the furnace blower three or four times, or as weather conditions indicate, to ventilate damp summer air.

When to Insulate and Where

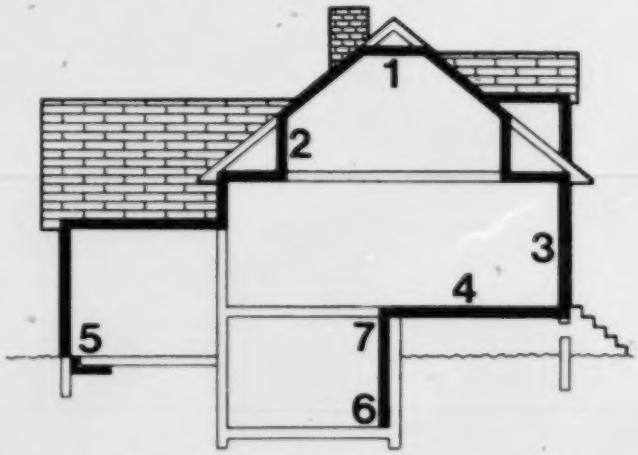
The best and easiest time to install insulation is during construction, but this is not possible for many homeowners. Adding insulation to an existing structure is sometimes difficult, but the time to start is now. Delay means continuing high costs for heating and cooling. The illustration below shows where a home should be insulated.

Insulation Thickness

The thickness of insulation needed varies according to the part of the structure to be insulated and according to the cost of fuel used for heating. Types of insulation and R-values (thickness) are discussed on pages 16–17. Table 4 shows the minimum R-values recommended for homes in areas where annual heating degree days exceed 4500. (To determine the number of heating degree days for your area, see the zone map on page 5.) Batts, rolls, and loose fill

Where to insulate a home

1. Ceilings with cold spaces above
2. Rafters and "knee" walls of a finished attic
3. Exterior walls or walls between heated and unheated spaces
4. Floors over unheated or outside spaces
5. Perimeter of a concrete floor slab close to grade level
6. Walls of finished or heated basement
7. Top of foundation or basement wall



can be combined to achieve the desired R-value. For example, rolls of R-19 and R-11 can be used together to reach a total R-value of 30.

Table 4. Minimum R-values for homes in areas with annual heating degree days greater than 4500

Insulation	Where used
R-11	Walls, including basement; crawl spaces; heating ducts
R-13	Floors over unheated spaces; walls in very cold climates; heating ducts
R-19	Ceilings; floors in very cold climates
R-30	Ceilings (if walls are poorly insulated)

How Much Do You Need?

To determine the amount of material needed, multiply in feet (meters) the length times the width of the area to be insulated. If you plan to use a batt- or roll-type material, allow for waste by adding 5 percent to the calculated area.

Labels on insulation wrappers indicate the number of square feet (square meters) one bundle or bag will cover. Divide that number into the total square feet (square meters) of area you plan to insulate (plus waste allowance) to determine how much insulating material you need to purchase.

How to Check for Existing Insulation

A second or third owner of a home may not know if the ceilings and sidewalls of the home are insulated. An unfinished attic is very easy to check: merely look between the joists for insulation. If there is an attic floor, it will be necessary to pry loose a floorboard to check for insulation.

If 3" (7.5 cm) or less of thermal insulating material are already in the attic, add a minimum of R-19. If there are between 3" (7.5 cm) and 6" (15 cm) of insulation, add at least R-11.

To check for sidewall insulation, remove the cover from an electrical receptacle on an outside wall and, with a flashlight, check the wall cavity for evidence of insulation. If this is not possible, remove a framing board from a window to examine the wall cavity.

How to Install Insulation

Carefully read the sections on insulation materials and R-values, humidity, vapor barriers, and ventilation before undertaking an insulation project.

Preparation

Assemble all materials and equipment at your work site. Do not unwrap insulation packages until you are ready to use them; insulation expands when wrappers are removed.

Check an attic roof for leaks and make repairs before installing insulation. Wet insulation is ineffective, and in the case of cellulose, the insulation value will be permanently ruined.

Caulk all openings where ducts, pipes, or wires penetrate a floor, wall, or ceiling, and repair heating duct joints.

Safety and comfort

If you plan to install insulation, follow these safety and comfort tips:

- **When glass fiber insulation is handled, small particles of fiberglass are broken off. These particles cause skin irritation after prolonged contact. Wear a loose-fitting long-sleeve shirt and loose-fitting trousers. (Wash these clothes separately.)**
- **Use gloves and a face mask. A simple paper breathing mask is sufficient, but if the installer wears eyeglasses, a mask with a rigid plastic frame that fits snugly over the bridge of the nose is recommended. Such masks, available at building supply stores, reduce eyeglass "fogging."**
- **Provide good lighting. Use an extension light in a wire cage—a "trouble light"—that can be hung overhead, or even better, use a spotlight that can be clamped to a rafter or wall stud. Always suspend or hang a light; never put it on the floor where it might start a fire. Hang or clamp the light to one side of your work path. A long extension cord will probably be necessary.**
- **In an unfinished attic, the ceiling itself will not usually support the weight of an adult. A section of the ceiling will break out, and the person will fall through. Usually, this will only result in bruises; however, it is often a real challenge to repair the hole in the ceiling. You must work on the edge of the ceiling joists or use a "temporary flooring."**
- **When crawling on your knees in attics or crawl spaces, masons' or gardeners' knee pads or thick pieces of foam rubber taped around the knees will lessen discomfort.**

Attics and ceilings

Unfinished attic floors can be insulated with batt, blanket, or loose-fill material. Press — but do not crush — the insulation between the joists or trusses. Begin at the outer edge and work toward the center where it is easier to cut and fit. Cover the top plate, but leave a 3" (7.5 cm) ventilation path around the attic perimeter. Don't leave gaps; butt the material at trusses or cross bracing. If a second layer of insulation is required to reach the desired R-value, try to place it at right angles to the first layer. Try not to cover electric wiring. The National Electric Code requires that insulation be kept 3" (7.5 cm) away from recessed light fixtures.

Use unfaced material to insulate the space between the chimney and wood framing.

Insulate heating ducts — first making sure seams are sealed — and water pipes. If ducts are for heating **and** air conditioning, keep the vapor barrier on the outside of the insulation; otherwise a barrier is unnecessary.

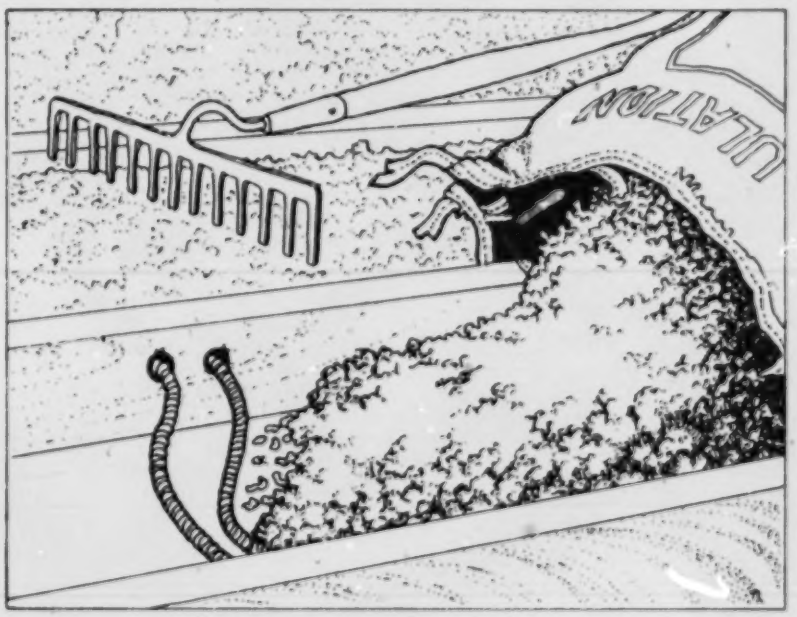
If using loose-fill material, maintain a consistent density. Do not crush the material: use a rake or board to level it. Use a baffle — a piece of batt insulation works well — to keep insulation away from eave vents and ventilation path.

Cover the inside of the attic opening or door with a piece of insulation. This can be stapled or taped in place.

A finished attic floor can be insulated by a do-it-yourselfer. The floorboards must be removed and the area between the joists filled with loose-fill, batt, or blanket insulation of the correct R-value. An insulation contractor can be hired to blow loose-fill material into the space between the attic floor and the ceiling below. (See "How to Choose a Contractor," page 7.)

After the attic floor is insulated and the floorboards replaced, it is wise to drill ¼" (6 mm) diameter holes into the floor. Space the holes 12" (30 cm) apart throughout the floor area. This will help prevent condensation on the floorboards in winter.

The do-it-yourselfer may opt to



install insulation in open areas of a finished attic. For hard-to-reach or finished areas, you will need to have an insulation contractor blow insulation into open joist spaces, between rafters, and into the floor of the outer part of the attic. In addition, have the contractor install batts in the knee walls. The exterior attic rafters, instead of the floor and knee walls, should be insulated if you wish to use that area for storage.

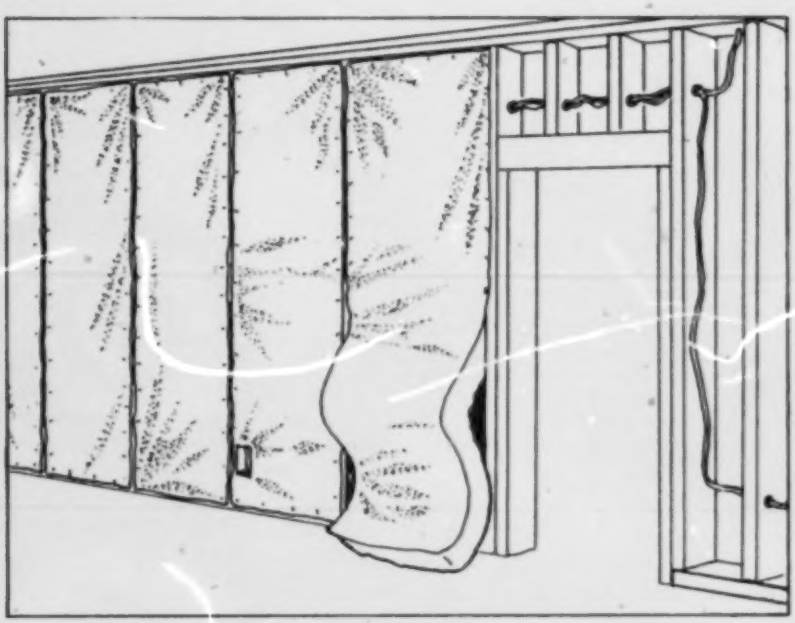
A structure with a flat or mansard roof is difficult and expensive to insulate. The work should be done by a professional. (See "How to Choose a Contractor," page 7.)

Dress for safety and comfort when installing insulation.

Sidewalls

Unless access to existing sidewalls can be gained from the attic, they must be insulated by a contractor. Carefully read the section on insulation materials (pages 16–17) before you make any decision about installing sidewall insulation.

Several precautions should be taken before you have any work done. If there is any plan or need for electrical rewiring, have the work done before insulating walls.



Do not add foam or blown-in insulation if another kind of material is already present in sidewalls. If existing sidewall insulation has settled and you want to add more insulation, add the same kind of material. Whereas it is very difficult to add a vapor barrier to an existing sidewall, accommodations must be made in the structure's interior. (See "Vapor Barriers," page 19.) Read and follow the recommendations in the section "How to Choose a Contractor," page 7, before you sign a contract.

Open frame walls are much easier to insulate. They are usually insulated with faced batt or blanket material. Cut the blankets slightly longer than the height of the wall so that they can be tucked at the top and bottom. Carefully press the insulation between the studs. The insulating material should touch the siding; the vapor barrier should face the heated side of the wall. Working from the top, staple the binding of the insulation to the face of the studs at 8" (20 cm) intervals.

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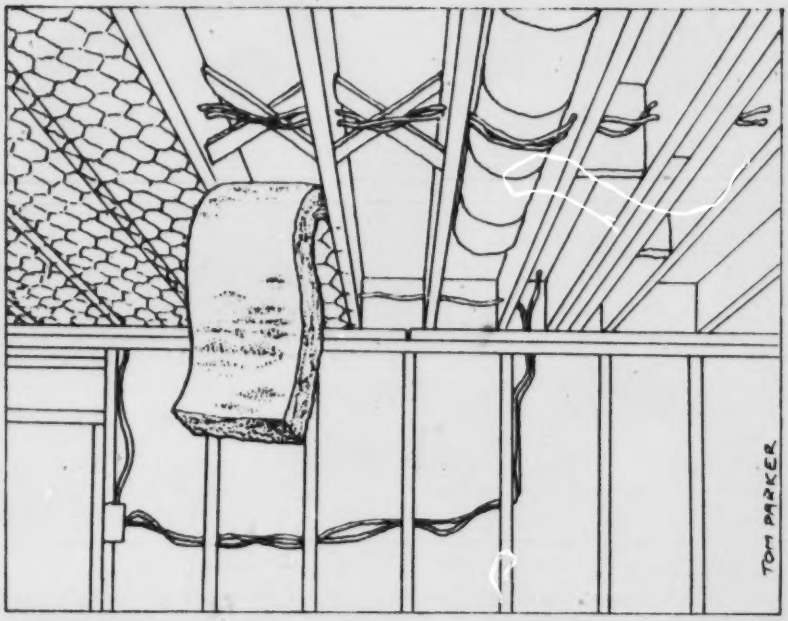
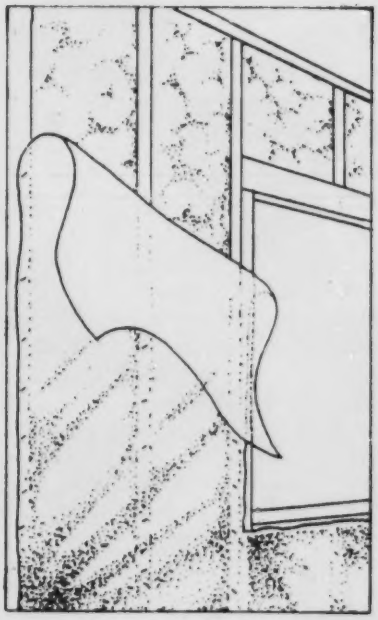
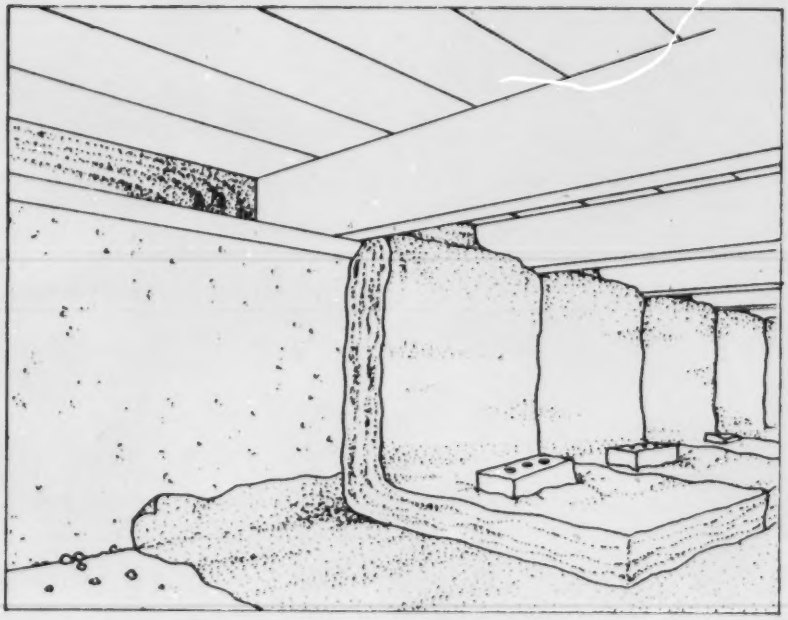




Work insulation behind outlet boxes, ducts, pipes, and around corners. Use small pieces to get around and behind window and door frames, sills, and header joists. These areas should then be covered with a vapor barrier.

Masonry walls can be insulated in much the same way as frame walls. Nail treated furring strips 16" (40 cm) or 24" (60 cm) on center to the wall and proceed as directed in the section on open frame walls.

Insulation can be blown into walls with a brick or stone veneer; however, it will probably be easier and cheaper to have the work done from the inside of the home.



Under floors

Insulation is needed under floors if the space below is unheated. Faced batt insulation is the easiest material to work with in this situation. The vapor barrier should face up; a ventilation space should be left between the vapor barrier and the floor.

Keep the insulation in place by lacing wire between the bottom of joists, or staple short sections of chicken wire across the joists and slide the insulation on top of the wire. Don't leave gaps!

Cover ducts and water pipes as described in the section on attic and ceiling insulation.

Crawl spaces

Follow the directions for installing insulation under floors for the overhead part of the crawl space. Requirements for vapor barriers in crawl spaces are described on page 20.

If joists run parallel with the wall, cut insulation to cover the height of the wall and 2' (60 cm) of the floor. Use nailing strips to attach the insulation to the band joist.

If joists run at right angles to the wall, nail the insulation to the sill plate. Fill the area between the sill plate and the subfloor with short pieces of insulation.

As a last step, weight the insulation around the perimeter of the crawl space with 2" × 4" lumber or rocks.

Costs and savings of insulation

Through adequate insulation, weather stripping, caulking, and the installation of storm windows and storm doors, it is possible to reduce heating bills 30–50 percent. Your precise percentage of savings depends on the energy efficiency of your home before you undertake the programs outlined in this manual, on the rates you pay for fuel and electricity, and on the severity of the weather. One thing is certain: you will save money.

The cost of insulating your home depends on whether you do the job or have it done by a contractor. It also varies by locality. If you choose to do the job yourself, watch advertisements of building suppliers, home centers, and mail-order houses. Sales of insulation materials are quite common. The installation of insulation qualifies for a home improvement loan. Loan terms are discussed on page 15.

At the time of this publication, federal and (or) state tax credits for insulation are pending. Your local office of the Internal Revenue Service can tell you if and when tax credits are available for energy-saving improvements in your home, and their amount.

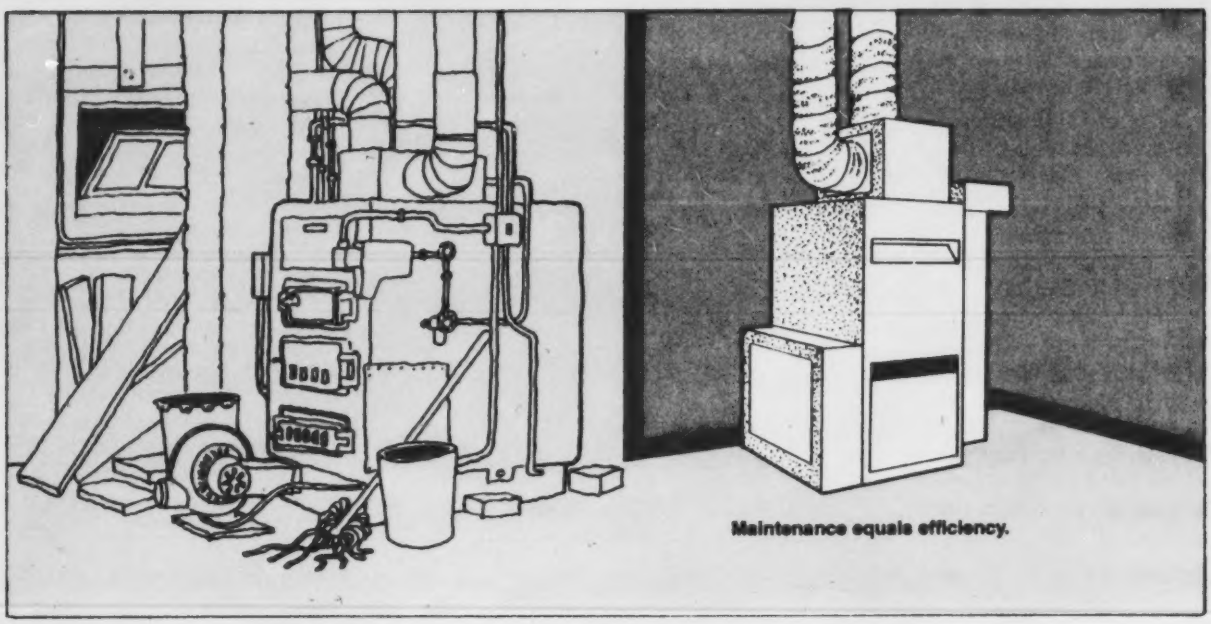
HOME HEATING EQUIPMENT

In northern climates, a heating system can be considered the heart of a home. Your comfort depends on its efficient operation. A heating system encompasses your furnace or baseboard heating units, ductwork, radiators or registers, chimney, and thermostat(s).

Space heating accounts for as much as 75 percent of all energy used in homes located in the northern part of the United States; therefore, well-maintained, properly sized equipment is essential.

Furnace Maintenance

Having your heating equipment serviced by a reputable heating specialist before the start of each heating season could reduce your fuel bill as much as 10 percent and could save you the discomfort and expense of equipment breakdown during the winter.



Maintenance equals efficiency.

If your furnace is fired by oil or gas, have the maintenance contractor clean the furnace and flue outlets, check the belt for tension and wear, oil the motor and fan bearings (if they are not sealed), change or clean the filters, check combustion and safety devices, and make other adjustments or tests recommended in your owner's manual. Be sure that there is sufficient outside air for combustion. This can be a problem in a very airtight house.

Gas furnaces with pilot lights should be checked for a clean, blue pilot flame, and the sensing unit should be cleaned.

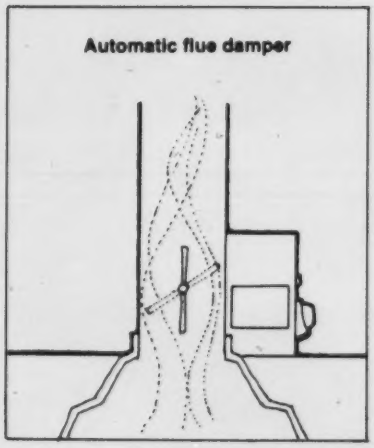
There are several things you can do to keep your furnace running efficiently. Check furnace filters every 2 months during the heating season; clean or replace them as needed. Clean the fan blades annually. Keep the area around the furnace housing free of dust, lint, and litter.

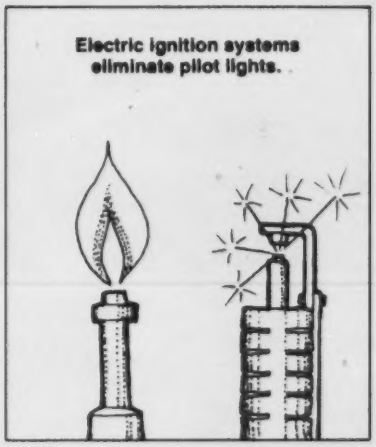
Learn to recognize trouble signals: odors, soot at the burner, black smoke rising from the chimney, or surging water in a boiler gauge indicate malfunction or improper adjustment. Get professional assistance.

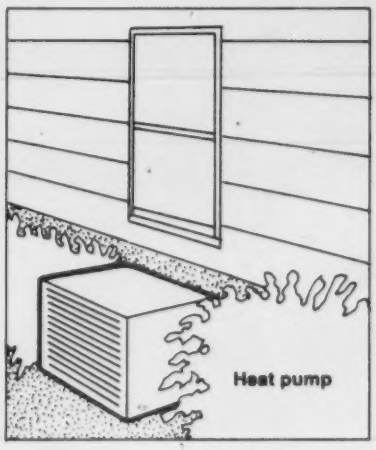
An electric furnace requires little maintenance. Follow the manufacturer's recommendations.

If one area of your home gets more heat than it needs, or if some rooms become hot before others are even warm, your heating system probably needs to be balanced. Have this done by a heating service specialist.

If you have a hot water baseboard heating system, consider adding thermostats, valves, and piping to provide zone heating for several areas.







Furnace Size

The blower on your furnace should run almost continuously on a **very** cold day. If not, the furnace may be too large. This is frequently the case in a home insulated after the furnace was installed. An oversized furnace or burner wastes fuel. Have your utility company or heating contractor test the system and advise you if the size of your furnace burner can be reduced.

If your furnace runs constantly on a cold day, yet your home does not warm up to the thermostat setting, the furnace is either too small or not operating properly. Get professional advice.

New Equipment

Good furnaces last for many years, but not forever. When the time comes to replace yours, make sure the system you choose serves your needs and the size of your home. Energy-conserving heating equipment is now available. This equipment costs more than standard equipment, but makes efficient use of the energy required for operation. In the face of rising fuel costs and limited resources, energy-saving features on furnaces will more than pay for themselves in lower fuel bills. At the time you select a new furnace, see if the equipment can be adapted to a second back-up system. Deal with a reputable heating firm.

Automatic flue dampers close immediately after the heat cycle; thus a much greater proportion of the heat generated by the furnace stays in your home instead of going up the chimney. Automatic dampers are available for use with oil-fired equipment; approval for use with gas is pending. They do not apply to electric heat.

High-speed flame-retention oil burners are also new. Such units can reduce fuel consumption by 10 percent.

Automatic ignition for gas-fired systems is also available. These systems ignite with an electronic spark, which eliminates the pilot light, an energy waster.

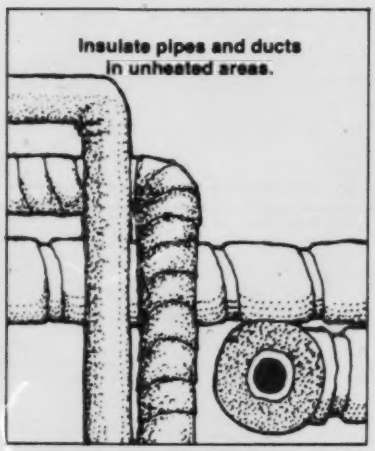
Heat pipes or reclaimers conduct heat from flue gases to a warm-air duct; however, a potential problem exists in them. Too much heat reclaiming ruins the draft in a chimney which could create health and fire hazards. Therefore, it is essential to deal with an experienced professional if you consider installation of a heat pipe. Heat pipes do not apply to electric heat; approval is pending for use with oil- and gas-fired heating systems.

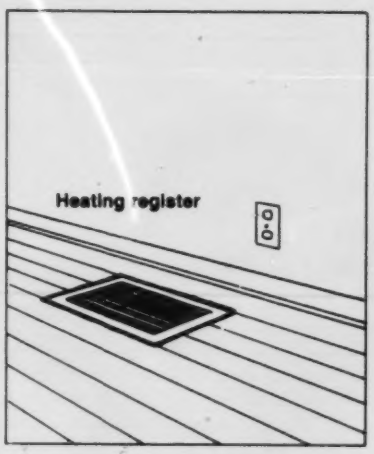
A heat pump can best be described as a two-way air conditioner. In winter, a heat pump extracts heat from the outside air and, through ducts, transfers it to the home at a higher temperature. The system is reversed in summer: heat is transferred from the home to the outdoors. Heat pumps are available as central systems and in room-size units.

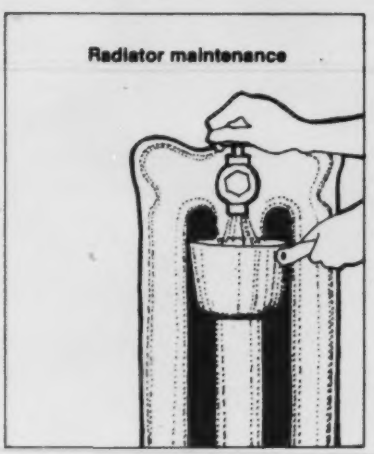
For operation, a heat pump used in the Northeast consumes approximately half the electricity required by an electric-resistance heating system. A heat pump does require supplementary electric-resistance heating for times when outdoor temperatures are below the balance point of the system, approximately 20°–28°F (−7° – −2°C), and for times when the automatic defrost system is operating. The initial cost of a heat pump is higher than most conventional heating systems; maintenance costs may run slightly above those for other heating systems.

Insulation is very important to heat pump efficiency. Heating–cooling ducts should be covered with R-11 thermal material. In the rest of the home, R-30 insulation is recommended for ceilings, R-11 for sidewalls and heated basements, and R-5 for unfinished basements.

A reputable heating–cooling contractor can supply you with more information on heat pumps.







Heating Ducts and Piping

Inspect heating ducts annually for leaks, and repair them with a quality duct tape.

Heating ducts and water or steam pipes that pass through unheated areas — attics, crawl spaces, and basements — should be covered with duct insulation or unfaced R-11 insulating batts or blankets. If ducts are used for air conditioning as well as heat, use faced insulation and place the vapor barrier on the outside to prevent condensation on the duct.

Radiators and Registers

Because they are integral parts of your heating system, registers and radiators require special care and attention.

Dust on radiators, convectors, baseboard heating units, or in ducts acts as insulation and wastes heat. Vacuum regularly.

Concentrate heat where you need it: living areas, bathrooms, and study areas. Lower temperatures in the kitchen, bedroom, and less active areas. If your home is equipped with zone heating (more than one thermostat), reduce the temperature in these areas. Turn off heat in unused rooms.

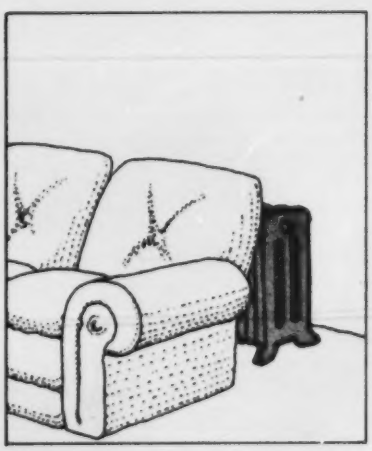
Adjust hot air registers or the control louvers on hot-water baseboard systems to satisfy your

heating needs. If your registers are not adjustable, consider replacing them.

Bleed air from hot-water-system radiators annually: open each radiator valve, hold a cup under it, and keep it there until water comes out. Don't drain the water; you only need to remove the air, which inhibits water circulation.

For best performance, paint radiators with a special radiator paint. Metallic paints and casings built around radiators reduce heat transfer as much as 25 percent. If it is important to you to use radiator covers, select a style that has grilles over 75 percent of the surface. Install a sheet of metal or aluminum foil behind radiators near cold walls so that heat will be reflected into the room.

Don't block air inlets and outlets, including radiators, with furniture, drapes, or clothing.



Chimneys and Flues

In homes heated with gas or oil, a chimney expels residue furnace gases. The flue is the passage in the chimney through which air and gases travel.

Chimneys, flues, and flashings should be inspected each fall for loose bricks and mortar, cracked linings, and leaks. Prompt repairs should be made.

Thermostats

A thermostat is a temperature-sensitive control for heating or cooling equipment. Your automatic heating system has such a device. To operate satisfactorily, a thermostat must be properly located and maintained since its operation influences the amount of fuel used for heating.

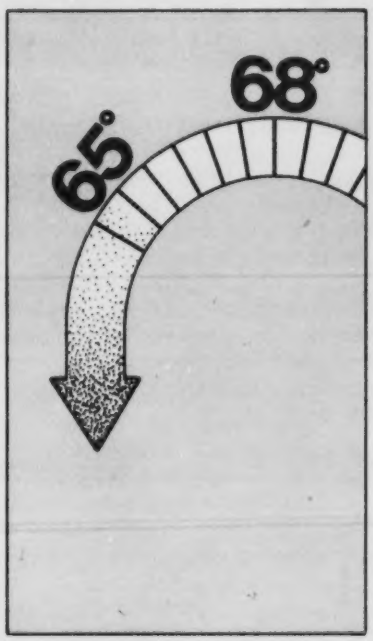
If your home has a single thermostat, it should be located on a central, interior wall in the living area. A thermostat will sense localized hot and cold spots around it rather than the average interior temperature of a room. It should be located away from heat sources such as stoves and fireplaces, heating vents and radiators, electric lights and televisions, and sunlight and away from cool or drafty areas such as windows, doors, and interior halls. If drafts are noticed, a shield can be placed around the perimeter of the thermostat; however, a thermostat should not be enclosed completely.

Zone heating utilizes several thermostats and, if used wisely, saves a considerable amount of heating fuel. If your home has zone heating, close doors between heating zones or install doors if there are none.

Maintenance of a thermostat is important to efficient operation of your heating system. Have your thermostat(s) checked seasonally by a heating service specialist. This can be done when your furnace is serviced. The dust should be removed, the accuracy checked and improved if necessary, and the contacts cleaned, if possible. If a thermostat is off by 1 degree, it can affect your fuel bill as much as 3 percent. You can check your thermostat's accuracy with a centrally located, reliable thermometer; but if a discrepancy is noted, a professional should be called in to make adjustments.

A thermostat must be perfectly level to operate properly. Have this checked and adjusted during seasonal servicing.

If you notice a great variation in room temperatures between heating cycles (the time when the burner is not running), the anticipator mechanism of the thermostat may need adjustment. This, too, should be done by a professional.



A thermostat setting of 65°–68°F (18°–20°C) provides sufficient heat for normal daytime activity and comfort, although young children and the elderly may require more. Whereas less heat is required when sleeping, a thermostat setting of 60°F (16°C) or lower is recommended for nighttime hours. In the Northeast,

an around-the-clock setback of 5°–8°F (3°–5°C) from current level will reduce fuel consumption 15–20 percent. Many people regularly turn their thermostats back to 55°F (13°C) at night and find a much more comfortable sleeping condition.

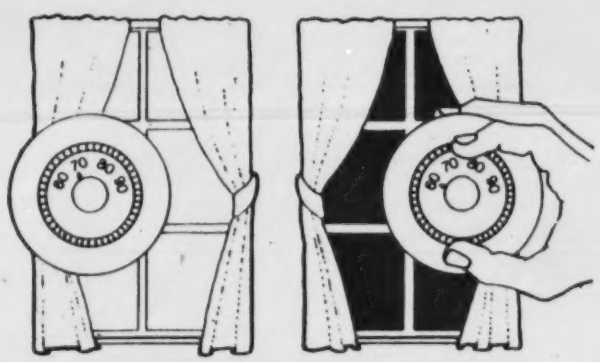
A clock thermostat automatically takes care of day and night temperature adjustments. Set the daytime setting for a half-hour before you get up in the morning and the nighttime setting for a half-hour before you retire. Other energy-saving thermostats available through a heating contractor or building supply store include light-sensitive devices and thermostats that run on battery-operated timers.

If your home has zone heating, set the thermostats for the activity of the area: higher temperatures in bathrooms, study, and living areas; lower temperatures in the kitchen, sleeping, and less active areas.

Don't reset your thermostat higher than needed: your furnace will not produce heat any faster and you may forget to turn it back. Constant resetting of a thermostat increases fuel consumption. Determine satisfactory and regular settings and stick with them.

Additional tips

- **During winter vacations or long periods away from home, reduce your thermostat setting to 50°F (10°C).**
- **If your home has one thermostat, adjust radiator valves, dampers in air ducts, or heat registers. Concentrate heat where you need it; lower the temperature in less active areas.**
- **Warm, loose clothing and sweaters are energy- and money-savers during the heating season. By regularly wearing a sweater, you might comfortably lower a thermostat 3°F (2°C) and save as much as 10 percent on your fuel bill.**



RECOMMENDED THERMOSTAT SETTINGS

SUPPLEMENTAL HEAT

Fireplaces and wood stoves have been popular decorative home accessories. Now, with the advent of the energy crisis, people are seeking ways to reduce fuel bills. Fireplaces and stoves are regaining some of the importance they held decades ago when they were the main source of heat in a home.

Unless properly installed and used, fireplaces and stoves waste as much heat as—or more than—they produce and may present serious fire hazards. As a rule, a wood stove is approximately 4 times more efficient than a fireplace.

Fireplace Maintenance

If you regularly use a fireplace, an annual fall check-up is in order. Hot gases that escape through cracks in a fireplace can be a hazard to health and can cause a house fire.

Check the chimney for loose bricks and mortar and the flue lining (the passage in the chimney through which air and gases travel) for cracks. Make repairs before you use your fireplace.

Be sure that the damper at the top of the fireplace closes tightly; otherwise, large volumes of warm room air will escape when the fireplace is not in use.

In summer, the damper should remain closed to prevent "sooty smelling" back drafts and to prevent birds from gaining access to the home.

Accumulated soot and creosote should be cleaned from the flue each year. To do this, pull a weighted sack of straw up and down the flue. Seal the front of the fireplace before you begin the job to prevent material from entering the living area. A commercial

cleaning contractor can clean a chimney with a vacuum system which is much more efficient than any do-it-yourself method.

Freestanding Fireplaces and Wood Stoves

Exercise extreme caution when you install a freestanding fireplace or wood stove. The recent increase of house fires in the United States is attributed mainly to faulty installation of stoves and to lack of care in kindling and maintaining wood fires.

Many types of stoves are available in a variety of materials. Your best and safest choice is a stove made of cast iron which is durable and spreads heat well. If used with coal, such a stove should be lined with firebrick and have a grate specifically designed for coal. Some stoves and freestanding fireplaces are double-lined (jacketed) and are sometimes labeled as zero clearance. They can be placed close to walls. A single-jacketed stove **must** have proper clearance from floor, walls, and ceilings.

If you purchase an old cast-iron stove, have it checked by someone knowledgeable in its operation.

Buy from a reputable dealer and arrange to see a similar stove in operation before you make a purchase. Follow the manufacturer's maintenance instructions.

Installation of Wood Stoves

A wood stove must be set on a foundation of stove board, slate, brick, or other fireproof material.

If you use a prefabricated chimney, make sure it is insulated and carries a U.L. (Underwriters' Laboratories) "All Fuel" label. **Do not use a chimney labeled "Vent."** A vent pipe is a single thickness of metal. Such a pipe gets very hot and can start a fire in any combustible materials near it in a wall or ceiling. "All Fuel" chimneys are either a double thickness of pipe with asbestos between the pipes or a triple-walled pipe with an air gap between the pipes.

Any smoke pipe that must go through a wood frame ceiling or wall should have a properly sized U.L. "All Fuel" thimble. The opening in the wall or ceiling should be 1" (2.5 cm) larger than the thimble and should be lined with asbestos. A smoke pipe must be at least 18" (45 cm) from an unprotected wall.

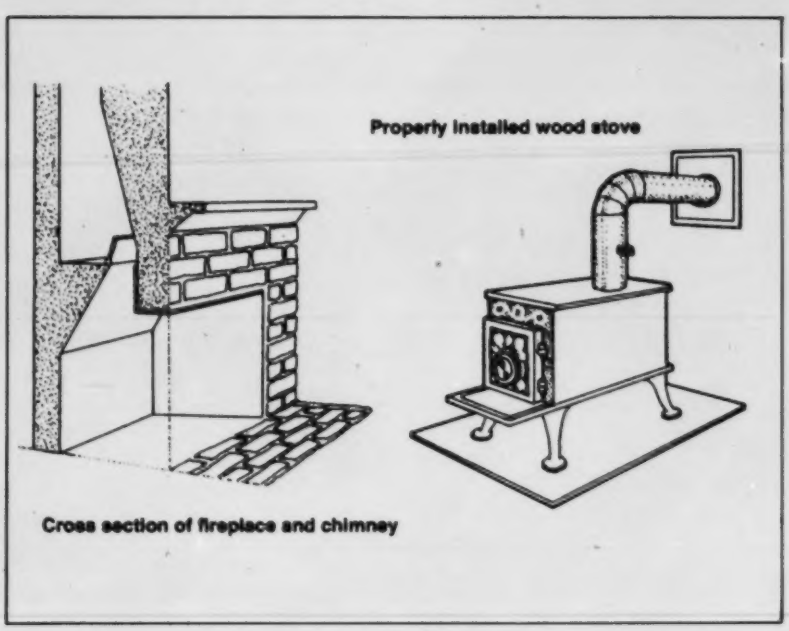
It is safest to have a wood stove installed by a competent dealer.

Safety Practices

Safety precautions must be taken whenever wood is burned to prevent damage from sparks, soot, and chimney fires and to prevent personal injuries.

One approach to igniting a fire would be to open the damper and place two logs on the grate or fire basket. Between them place wadded newspaper and small pieces of wood or branches. Place small, dry logs over this: a teepee shape works well. Ignite near the base of the teepee. Once the logs have ignited, move them close together and close the fireplace screen or stove door. Before adding new logs, rake the coals to the front of a fireplace grate where they will reflect heat into a room. Always be sure that an inch (2.5 cm) or more of space exists under the grate or andirons and above the ashes for air circulation and to protect the metal from excessive oxidation. Add pieces of firewood sparingly. Maintain a quiet, cozy fire; avoid a roaring blaze.

Don't close the damper entirely until the fire is completely out. This may take several hours after the fire burns down. The next day, rake through the ashes before you remove them.



Cross section of fireplace and chimney

Properly installed wood stove

Consider using a combination screen-tempered glass unit with your fireplace: the screen is used while the fire is burning; the glass doors are closed when the fire is reduced to embers.

Insist that all members of a household follow these safety rules:

- **Keep flammable materials away from the fire.**
- **Never leave small children unattended in a room where a fireplace or stove is in use.**
- **Allow only adults to tend the fire.**
- **Keep fireplace screens and stove doors closed while the fire is burning.**
- **Clean the fireplace or stove regularly. Maintain an inch (2.5 cm) of ashes to improve the refractory effect on burning fuel.**

Wood Selection

Fireplace and stove wood should be dried as much as possible before burning. Dry wood burns more efficiently and is not as likely to produce soot and creosote problems. To make the most efficent use of wood, cut it to size and store it under cover at least 6 months before using it. Consult table 5 for the burning characteristics of wood.

Electric Heaters

Auxiliary electric heaters are useful for temporary, localized heat. To save energy and dollars, use them only when necessary. If you need auxiliary heat in your bathroom(s), a wall or ceiling radiant fixture connected to a timer is the ideal arrangement.

Portable heaters should be used with caution in bathrooms or other areas where water might come in contact with them.

Be very careful to watch young children around any portable heater. Also, be sure that no combustible items such as clothes or toys are left on, in front of, over, or near any portable heater.

Additional Tips

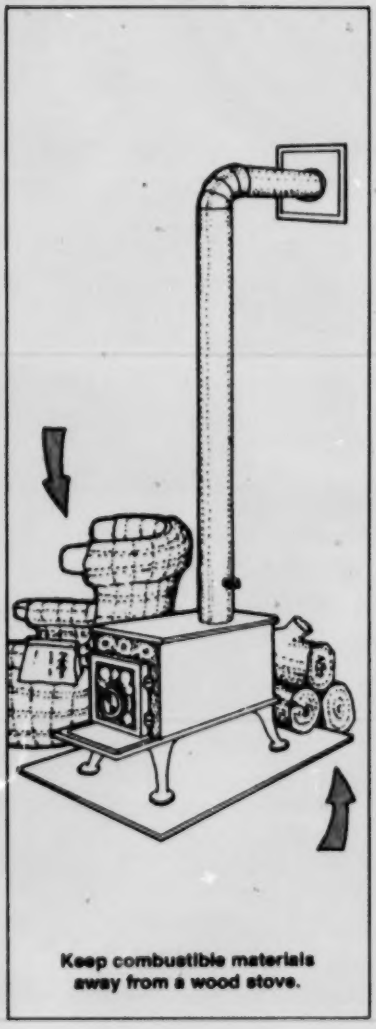
- **If you have any doubts about the safety of your fireplace or stove, ask your local fire department to inspect it before you use it.**
- **Don't burn charcoal indoors: it can consume most of the available oxygen in a room. This also applies to liquid propane (LP) camping heaters and to kerosene space heaters. The sale of portable, unvented kerosene heaters for household use is prohibited by law.**
- **For reasons of fire safety, a sunlamp should never be used for supplemental heat.**
- **If you plan to build a fireplace, consider installing a heat-circulating firebox. Air can be circulated from it throughout a room or to several rooms. Electric fireplace grates draw cool air from a room into tubes where it is heated and returned to the room. Consider one if you use a fireplace as a regular**

Table 5. Characteristics of Northeastern U.S. woods for fireplace use

Species	Ease of starting	Coaling qualities	Sparks	Fragrance	Heating class (I best)
Apple	Poor	Excellent	Few	Excellent	II
Ash	Fair	Good	Few	Slight	II
Beech	Poor	Good	Few	Slight	I
Birch (white)	Good	Good	Moderate	Slight	II
Cherry	Poor	Excellent	Few	Excellent	II
Cedar	Excellent	Poor	Many	Good	III
Elm	Fair	Good	Very few	Fair	II
Hemlock	Good	Low	Many	Good	III
Hickory	Fair	Excellent	Moderate	Slight	I
Locust (black)	Poor	Excellent	Very few	Slight	I
Maple (sugar)	Poor	Excellent	Few	Good	I
Oak (red)	Poor	Excellent	Few	Fair	I
Pine (white)	Excellent	Poor	Moderate	Good	III

and major source of heat. An ash dump built into the hearth and chimney is a great convenience. Ashes can be emptied through a clean-out door in the basement.

- **Save your wood ashes. They are full of potash (potassium) and make an excellent fertilizer for a vegetable garden in the early spring. Keep the ashes dry until ready for use.**



Keep combustible materials away from a wood stove.

COOL YOUR HOME THE ENERGY-EFFICIENT WAY

Several of the energy conservation measures taken to prevent heat loss from a home in winter serve equally well to keep it cool in summer. Insulation and landscaping help to retain heat in a home during the winter. In summer, they work in reverse: they limit heating caused by the sun. Attic louvers vent excess moisture in winter; in summer they expel excess heat.

In the Northeast, summer comfort in a home can be increased in a variety of ways that make little or no demand on your energy dollar.

Daytime Cooling

With a few simple adjustments, you can ward off a sizeable amount of summer heat. Keep windows and doors closed during the hottest hours of the day and draw draperies and (or) blinds on sunny windows. Light-colored draperies and drapery linings reflect heat to the outside; dark colors absorb heat. Awnings or bamboo shades will help protect the south sides of a structure from sun.

If possible, cook and run heat-generating equipment — range, washer, dryer, and dishwasher — during early morning or late evening hours. Electric lights also generate heat; use them sparingly on hot days.

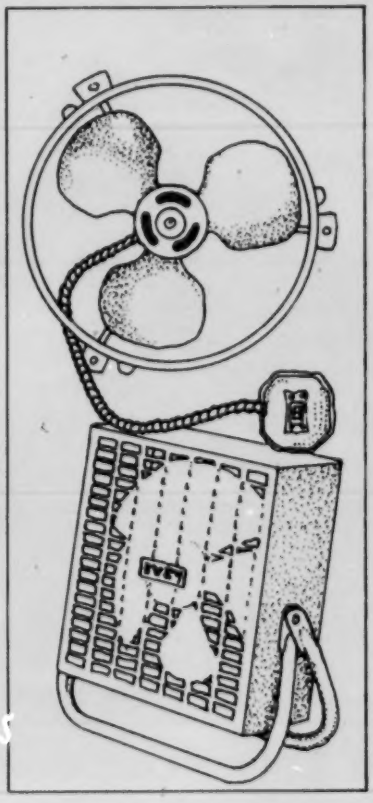
The moisture generated in the kitchen, laundry, and bathroom tends to increase humidity in other areas of the home. Use exhaust fans as needed, and keep doors closed in heat-generating rooms when equipment is in use.

Take advantage of solar energy by putting up a clothes line and drying clothes outdoors. If you do this regularly, it will make a definite dent in your utility bill.

Summer heat puts extra demands on your refrigerator. Keep equipment in top operating condition; defrost as needed; and don't open the door unnecessarily.

Nighttime Cooling

During cooler evening hours, open windows, top and bottom, to vent built-up heat from your home. Open pairs of windows, opposite one another, for cross ventilation. If your attic is ventilated, open the door. Cool air will enter your home through open windows on the lower floor(s); hot air will rise and pass out through the attic.



Fans

Fans may be necessary to vent built-up heat when little air is moving outside and when the inside temperature of a home is greater than the outside temperature. The movement of air increases moisture evaporation which, in turn, cools the air.

Window fans ventilate more efficiently than portable or roll-about fans. (Window fans exhaust heat to the outdoors and should be set up accordingly.) Attic fans ventilate best of all.

The capacity of a fan is determined by its "CFM" (m^3/min) rating, the cubic feet (cubic meters) of air moved per minute. To determine the CFM (m^3/min) rating you need for an attic fan, multiply in feet (meters) the length of your home times the width times the height (from ground level to just below the attic) and divide the figure by 10. A fan with a CFM (m^3/min) rating close to your calculated figure will provide adequate ventilation for your home.

Don't run an attic fan around the clock; that wastes energy. Instead, control use by means of a manual switch and (or) timer connected to the fan.

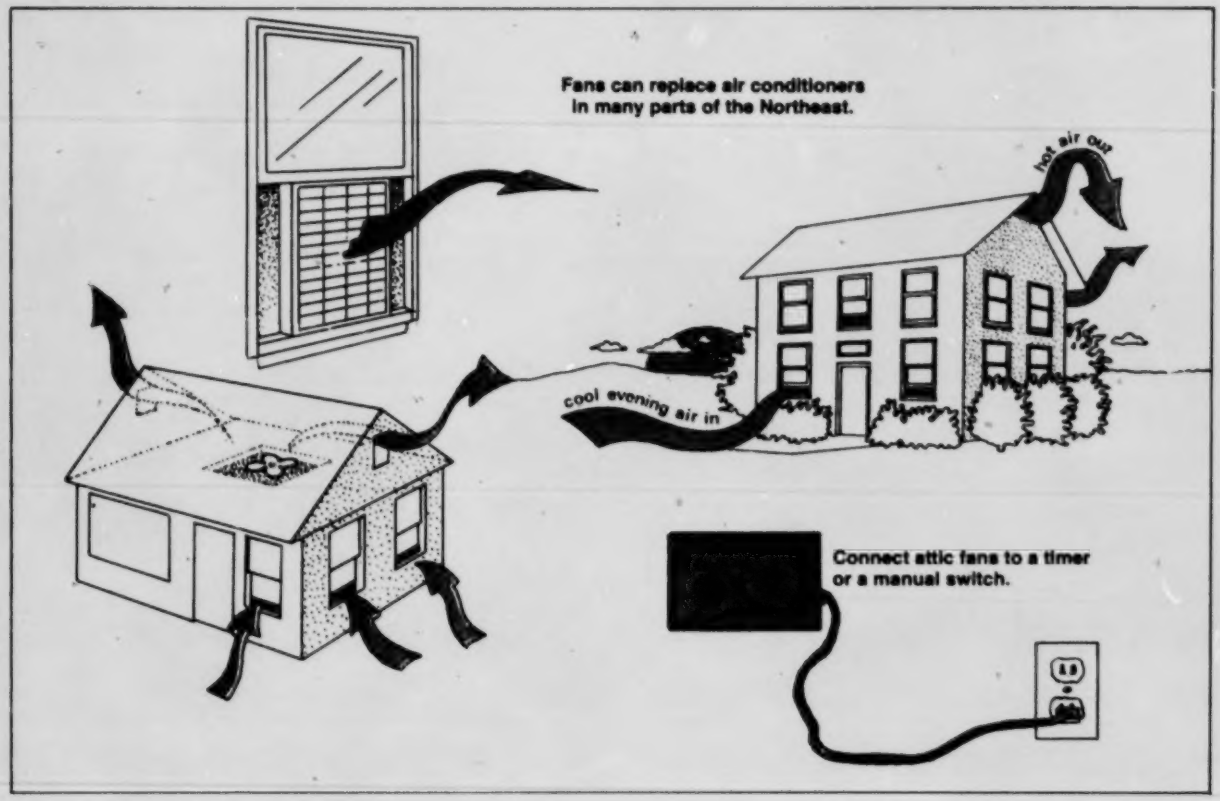
The attic door should be open when the fan is running. If this is not possible, install a louver in the ceiling between the living area of a home and the attic.

Attic fans use much less energy than air conditioners. In those parts of the Northeast where hot days and cool nights are the rule, an attic fan can easily replace an air conditioner.

Air Conditioners

Before you buy an air conditioner, try cooling your home through the measures outlined in the preceding sections. In many cases, you will find they are sufficient to maintain summer comfort. But if you live in a home or area where intense summer heat and humidity are common, or if allergies create health problems, an air conditioner may be your only means of relief.

Air conditioning units—window or central—are energy gluttons; therefore, to save energy and dollars, correct size, efficient operation, and prudent use are essential.



Fans can replace air conditioners in many parts of the Northeast.

Selection

Select an air conditioner according to the size of the area you wish to cool. An oversized unit goes on and off frequently. It lowers the temperature quickly but does not remove humidity. An undersized unit runs constantly but does not do the job you want it to. Both consume needless amounts of energy.

An air conditioning specialist can best advise you on size requirements for central or window units.

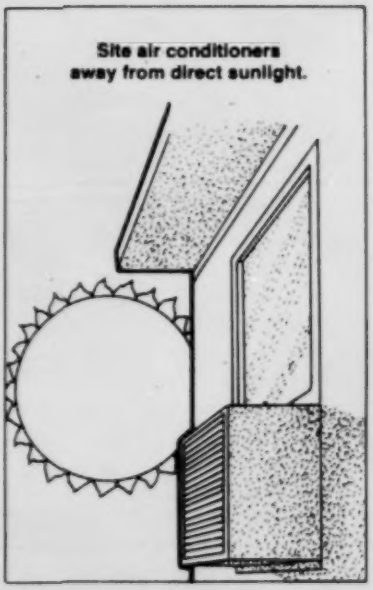
Operation

A thermostat setting of 78°F (26°C) or above is recommended for air-conditioned homes. If your space unit does not indicate degrees of coolness, check the temperature with an indoor thermometer. If the thermometer reading is not 78°F (26°C) or above, adjust the unit's temperature control.

Close all windows, doors (including closets), and unused rooms when an air conditioner is running. Caulking, weather stripping, and adequate insulation all contribute to the efficient operation of a cooling unit.

Turn off an air conditioner when no one is going to be at home. Connect a timer to the unit and set it to turn on the equipment a half-hour before you arrive home.

That portion of the unit extending or sited outdoors, the condenser, should be protected from direct sunlight; siting on the north side of a home is usually best. Also, cut back vines and shrubs from the condenser and keep it free of leaves, grass clippings, and debris. Draw draperies and shades when operating an air conditioner, but don't block the unit with furniture or draperies.



Energy efficiency ratio

An air conditioner's energy efficiency ratio (EER) indicates the unit's cooling capacity divided by the number of watts required to operate it. The higher the EER, the less the unit costs to run. A cooling unit with a high EER is usually heavier, more durable, and, probably, more expensive than models with lower EERs. But an air conditioner with an EER of 10 will do the same amount of cooling on half the electricity as a comparable unit with an EER of 5. Typical EERs range from 4 to 12 and are labeled on units. For efficient use of energy, buy the highest EER-rated model available of the size required to cool your room or home.

Maintenance

Check an air conditioner's filter monthly; wash or replace as needed. Check the fan belt for tension and wear; replace as needed. Follow the manufacturer's instructions for other maintenance requirements and have the unit serviced at least every other year by an air-conditioning specialist.

Manual sections on furnishings, pages 55–56; landscaping, pages 59–60; insulation, pages 16–18; ventilation, pages 20–22; and appliances, pages 41–54, also contain useful information about cooling your home in summer.

3

Hot water: use and conservation

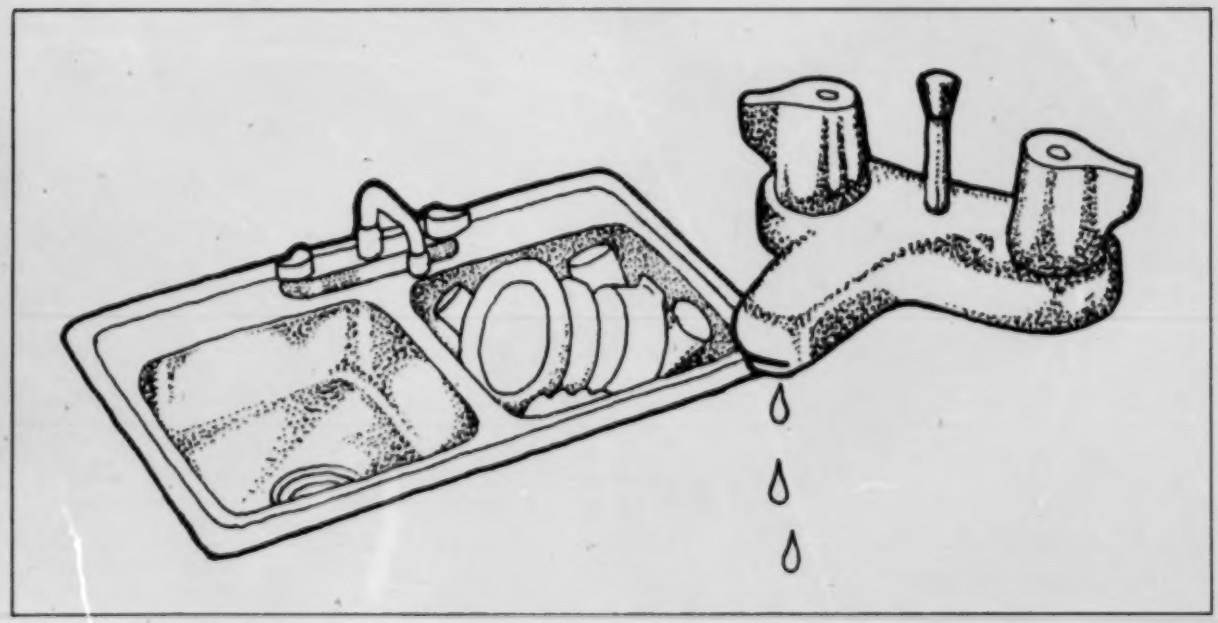
By simply opening a faucet, hot water is available in the kitchen, bathroom(s), and laundry of most American homes. Hot water is taken for granted and looked upon as an integral part of the household. Little thought is given to the cost of heating water because its use is constant rather than seasonal, as with a central heating system.

The heating of water accounts for a whopping 15 percent of your total energy bill. If your utility bill(s) ran $1,000 last year, that means you spent approximately $150 to heat water for your home. You can't do without hot water, but there are several ways to conserve it so that energy requirements and costs will be less.

Equipment

Residential water heating is accomplished with gas-, electric-, or oil-fired units. Gas and electric units are usually the automatic storage type, with the heater, storage tank, insulation, and controls all combined in a single unit. Oil-burning units commonly utilize a direct-fired water heater, with pipe coils in the boiler. Such units may or may not be combined with a hot water storage tank.

Hot water usage depends on the number of people in a household, the number of bathrooms, and on the presence and regular use of a clothes washer and (or) automatic dishwasher. Water heating units are specified in terms of tank size; rate of heat input; maximum

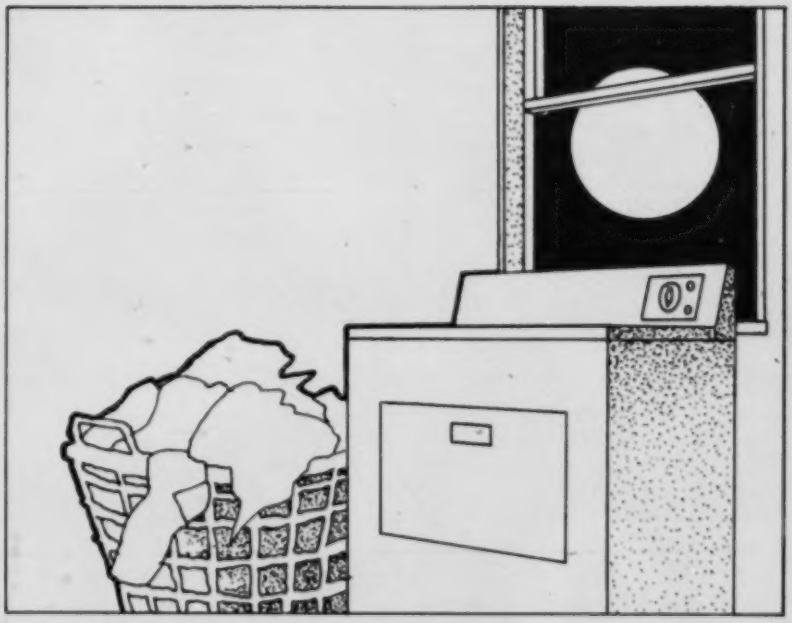


estimated hot water usage per hour; and recovery of reheating capacity, rated in gallons per hour. An oversized unit uses energy to keep unneeded water hot; an undersized unit cannot supply a sufficient amount of hot water.

The American Gas Association recommends a 30-gallon (115-liter) water heater for a family of two with one bathroom and an automatic clothes washer. For each additional person in the family and for each additional bathroom in the household, 3.5 gallons (13 liters) should be added to the tank capacity. If a dishwasher is used, the tank capacity should be increased by 5 more gallons (19 liters). A reliable heating and plumbing contractor can best determine the size tank needed in your household.

If you must replace a water heater, make energy efficiency your main criterion. Look for information indicating how efficiently the unit uses the energy required for operating it. Also look for a thickly insulated outer shell. When replacing a gas-fired unit, select one equipped with a low-consumption pilot which is matched to the rate of heat loss of the heater.

Relocate the unit, if necessary, as close as possible to areas of major hot water use. Use small diameter pipes for hot water supply lines to minimize heat loss and to reduce the volume of trapped water.



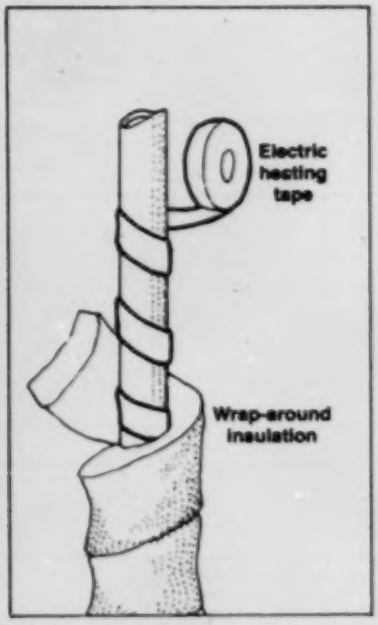
"Off-Peak" Water Heating

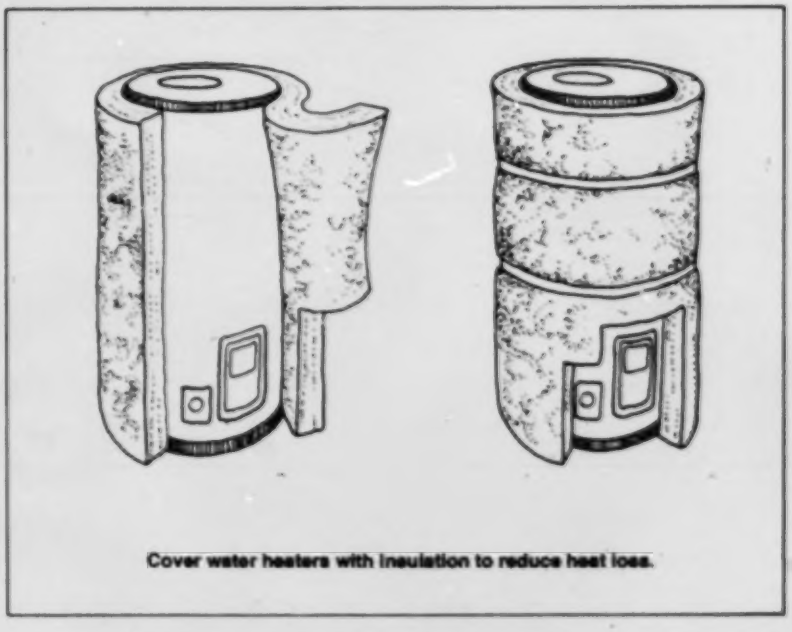
Some utility companies offer a special or "off-peak" rate to customers in an attempt to reduce peak electric demands and avoid the need to put into use back-up generating equipment which is usually more costly to operate and less energy efficient. Such rates, if available, apply during evening hours and are lower than rates for peak use. By gearing hot water usage to off-peak hours, it is possible to reduce the amount of money you spend for water heating.

Water heaters with dual heating elements are well suited to take advantage of this low rate. For example, in an 80-gallon (300-liter) tank, the common method of operation would be to connect the upper heating element, with a capacity of approximately 20 gallons (75 liters), for operation during peak hours, with the lower element, with a capacity of 60 gallons (225 liters), used only during the off-peak period. The reduction in cost of water heating can be quite significant.

One caution is that the lower element can be on **only** during the off-peak period. If hot water usage is heavy in the evening hours, the upper element alone may not heat water rapidly enough to provide a continuous supply. It would be necessary to schedule water usage, preferably for morning hours.

Even if your utility company does not presently offer an off-peak rate, try to reduce your peak hour hot-water demands. Take showers, do laundry, and run a dishwasher before 7:00 A.M. or after 8:00 P.M. or on weekends when there is less generating demand on utilities. Such practices will not lower your utility bill, but they will help conserve energy and will reduce the need for building additional generating capacity which, currently, is very costly.





Cover water heaters with insulation to reduce heat loss.

Thermostat Setting

A thermostat setting of 110°–120°F (43°–49°C) on a water heater is sufficient if you do not have an automatic dishwasher; a setting of 140°F (60°C) is recommended if you do have one. Temperatures over 140°F (60°C) shorten the life of a glass-lined tank.

Supplemental Water Heaters

If any hot water pipes have to run more than 70 feet (21 meters), consider installing a separate 20-gallon (75-liter) unit near the main bathroom; set the thermostat at 110°F (43°C). Or locate a separate 20-gallon (75-liter) water heater near the dishwasher and set the thermostat at 140°F (60°C). This will allow you to set your main water heater thermostat at 110°–120°F (43°–49°C). Over the life of a water heater, either will pay for itself in energy saved.

Maintenance

Twice a year (monthly if you live in an area with heavy mineral deposits in the water) empty a bucket of water from your hot water storage unit. The drain cock is located near the bottom of the tank. This will help remove sediment which insulates the tank from the source of heat and wastes energy.

Standby Losses

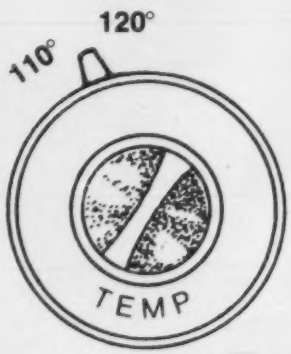
Heat losses from a hot water storage tank and supply lines can be significant. Examine your storage tank carefully; touch the surface. If it's hot, or even warm, some of the energy used to heat the water is being wasted. You can remedy this by wrapping unfaced batt or blanket insulation around and over the shell of the tank.

Pipe insulation is needed especially where pipes run through unheated areas such as basements or crawl spaces. Several types of insulation for wrapping or covering pipes are available at hardware or building supply stores. Insulate cold-water pipes as well in these areas to reduce the chance of winter freeze-up.

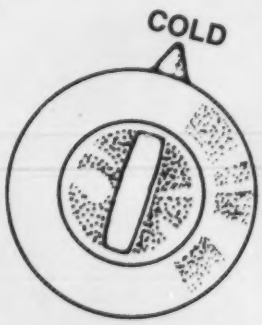
Electric heat tapes may be necessary in cases where pipes are exposed to extreme cold. Heat tape must be installed carefully. A tape should never overlap itself, or it will short out and could result in a fire. The tape should be spirally wrapped around a water pipe and secured in position with duct tape. Finally, the pipe and tape should be covered with insulation.

A leaking hot-water faucet is an energy waster and should be repaired immediately. The replacement of washers is a simple operation described in every basic homeowner's maintenance guide. A faucet that leaks one drip per second wastes 2,400 gallons (9120 liters) of hot water each year. That's enough to run 160 full cycles on an automatic dishwasher!

A flow restrictor reduces hot water consumption.



WATER HEATER



WASHER

Hot Water Conservation Tips

A simple rule-of-thumb applies to energy conservation and hot water: Every time you use cold water instead of hot you save energy and dollars. The following tips will help remind you of ways to reduce hot water consumption.

- **Wash only full loads of laundry. Use water level or load size devices on your clothes washer.**
- **Use as low a water temperature as possible for the wash cycle of your clothes washer. Use cold water for all rinse cycles. Presoak heavily soiled clothes before washing.**
- **Scrape dishes before placing them in a dishwasher. If rinsing is necessary, use cold water.**
- **Try to run your dishwasher no more than once a day or only when fully loaded. Use the shortest cycle that will clean the dishes. Between meals, store soiled dishes in the unit.**
- **When washing dishes by hand, fill a pan with hot water for rinsing. Don't let hot water run continuously.**
- **A flow restrictor can be purchased for as little as $1.50. Easily installed in a shower head, this device reduces the amount of water flowing from the pipe (but not the pressure) from 5 gallons (19 liters) per minute to 3 (11 liters).**
- **Take quick showers instead of baths; they use up to 50 percent less hot water.**
- **Don't let hot water run continuously when you shave. Close the drain and fill the basin with water instead.**
- **Turn down your water heater thermostat to a minimum setting if you plan to be away from home for an extended period of time.**

4

Energy efficiency and home appliances

The residential sector accounts for approximately 20 percent of all energy used in the United States. In the North, 70 to 85 percent of the energy consumed by the residential sector is used for space and water heating. (Efficient use of energy in these areas is covered elsewhere in **Save Energy, Save Dollars**.) Appliances and lighting account for the balance. No matter how little energy a single appliance uses, each is part of the energy problem and, therefore, part of the solution with regard to conservation of energy.

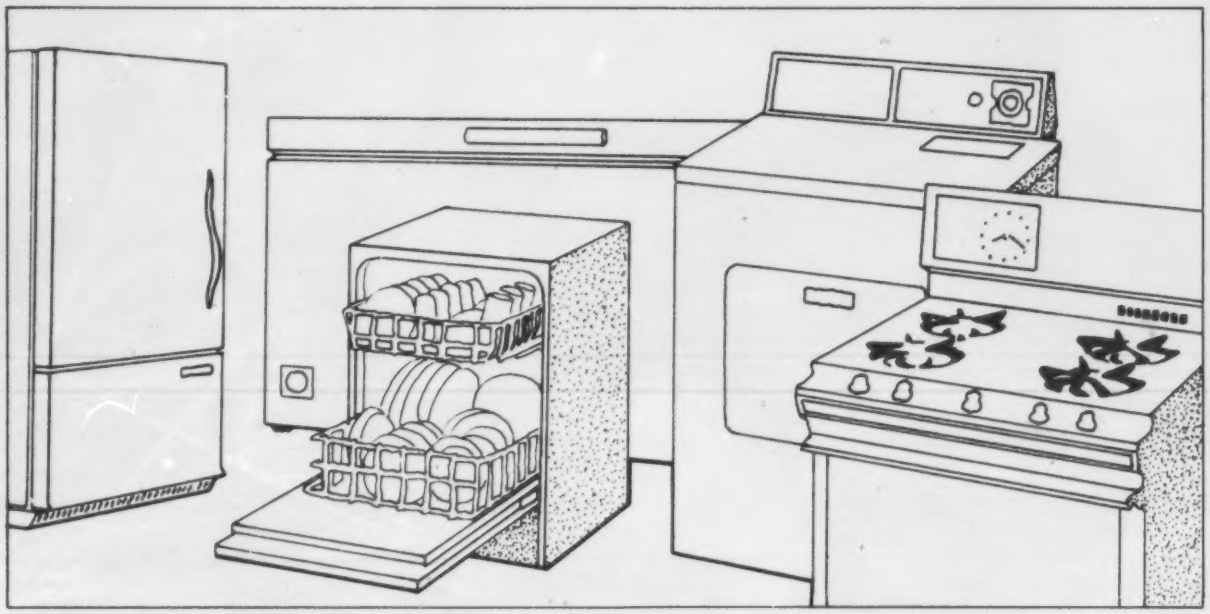
When you shop for an appliance, remember there is an energy shortage and energy costs are rising. Select with efficiency in mind. Ask yourself these questions:

1. **Is this appliance necessary?**
2. **Does this appliance make efficient use of energy?**
3. **Are optional energy-saving features available?**
4. **Can you cut down on features that increase energy consumption?**

The following pages will help you make thoughtful, energy-efficient decisions when purchasing and using appliances.

Energy Efficiency

Look for a label on an appliance that indicates how efficiently the appliance uses the energy required to operate it. Energy-efficient appliances usually cost



more than less efficient models; however, the difference in purchase price is usually repaid through economy of operation and maintenance.

Energy-efficiency information, available on air conditioners for several years, is now available for refrigerators, freezers, and water heaters. (Energy-efficiency information for air conditioners is discussed on page 36.) On refrigerators and freezers, energy information is given in estimated kilowatt hours used per month. Because estimates are determined under the same conditions of use, comparisons among models can be made. Look for models with lower energy requirements. Recognize that the amount of energy needed in your home may vary from the estimate based on standard conditions.

Energy ratings for other appliances such as clothes washers and dryers, ranges, and supplemental electric heating equipment are being determined. Look for them in the future as you shop.

The American Gas Association (AGA) and Underwriters' Laboratories (UL) seals on gas and electric appliances indicate that the appliances have met standards for safety. UL standards evaluate only the characteristics related to safety. The AGA standards, however, also provide procedures for measuring certain performance characteristics of the appliance, such as efficiency, under a set of standard laboratory conditions. The AGA seal on an appliance assures that the appliance has met the *minimum* requirement. Because of the way that the consumer uses the appliance (for example, bakes one potato or a whole meal in an oven), the efficiency rating from the standard test may be meaningless in relation to the energy used by the appliance in the home.

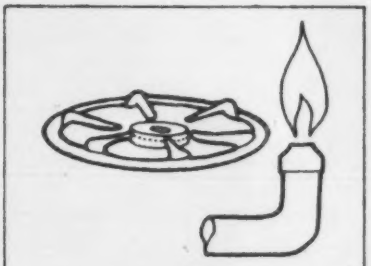
"Off-Peak" Use of Appliances

During winter months, most utility suppliers experience peak generating demands between the hours of 4:00 P.M. and 8:00 P.M. In summer, peak demand begins at 11:00 A.M. and continues until about 8:00 P.M. To meet these demands, utility companies use back-up generating equipment which is less efficient and (or) more costly to operate. Residential users can and should help relieve energy demands by scheduling dishwashing, laundry, and other energy-demanding tasks for "off-peak" hours—late evening or early morning.

To encourage off-peak usage, some utilities offer special rates to residential customers. These rates, involving a special or separate meter, are discussed on page 38 of the manual.

Pilot Lights

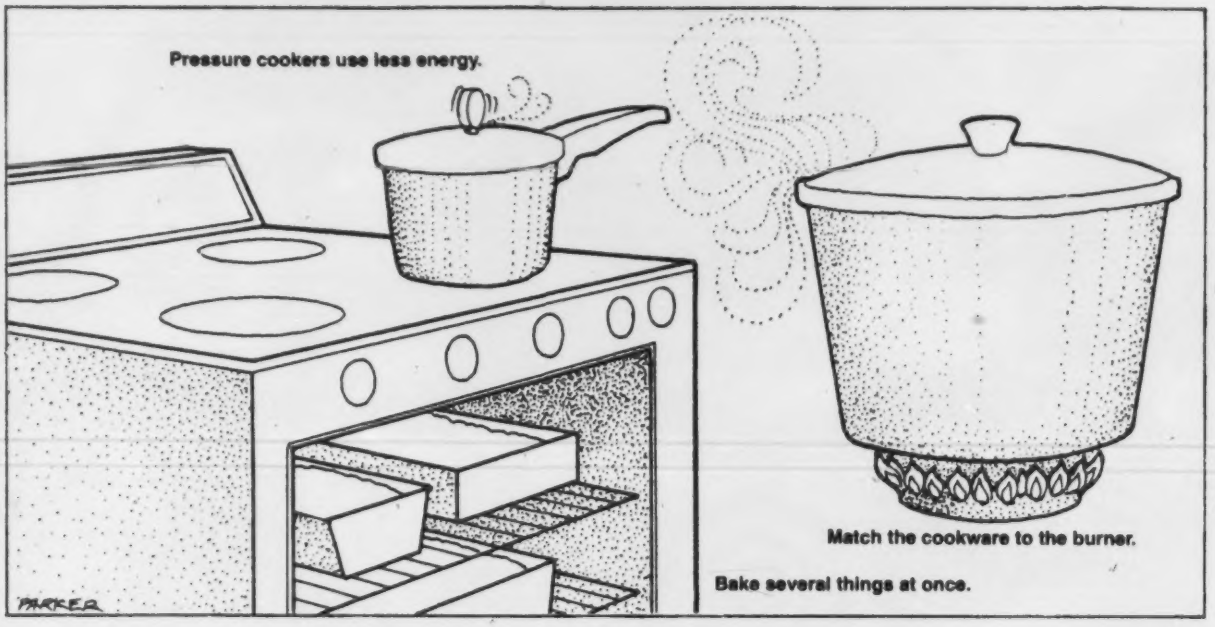
Pilot lights consume 5 to 10 percent of all natural gas used in homes. Though it is argued that pilot lights on water heaters and furnaces provide useful heat, other pilot lights do not make efficient use of energy and add unwanted heat in summer. Electric ignition systems eliminate pilot lights; they are available on ranges, space heaters, and dryers, usually at a slightly higher price. Look for models featuring electric ignition when you buy or replace a gas-fueled appliance.



A pilot light wastes energy.

FOOD PREPARATION

To take full advantage of your range, and at the same time save energy, maximum use must be made of its design and the heat it produces. A well-built, properly cared for range can give many years of service. When you buy a range, look for indications of efficient use of energy such as extra insulation around the oven and good reflective surfaces below the surface units. However, your own cooking habits, rather than the design of a range, are probably the most important factor in determining the amount of energy used in food preparation.



Choice of Energy

Gas ranges use energy less efficiently than electric ranges. For example, surface burners on gas ranges may be about 40 percent efficient, whereas surface units on electric ranges may be about 60 percent efficient. Although electric ranges are more efficient than gas ranges within the home, there is a loss of energy in producing electricity. When fossil fuels are used to generate electricity, about 33 percent of the energy used is converted to electricity; the rest is wasted.

The choice of energy source for cooking may be based on the efficiency of use of the energy; however, it will more likely be based on other considerations such as whether gas is available, whether the kitchen is wired for an electric range, and whether gas or electricity is used for other purposes such as space heating and water heating.

Top-of-Range Cooking

The efficiency of a surface unit or burner depends on the utensil as well as the range. Cookware with flat bottoms allows efficient heat transfer to the utensil. Choose utensils that are thick enough to maintain their shape through years of use. Match the pan to the unit or burner: the bottom of the pan should not extend more than 1" (2.5 cm) beyond the outer ring of the unit; similarly, the flame or coil should not extend beyond the pan. Match the shape and size of a cooking utensil to the size of the food load. Turn the heat down when the food reaches cooking temperature, and use the lowest possible heat level to complete the process.

Aluminum is frequently used for cooking utensils. Both aluminum and copper are good conductors of heat and spread heat evenly in the utensil. Stainless steel is not a good conductor. For improved spreading of heat for top of range cooking, use stainless steel pans with copper or aluminum bottoms. Because of its thickness, cast iron heats up slowly; it is better for long cooking processes than for short jobs. Glass and ceramic glass are poor conductors of heat for top of range cooking but are good absorbers of radiant (oven) heat.

Use a minimum amount of water for cooking. (It takes energy to heat water.) Pans should be straight sided and should be covered with tight lids, whenever possible, to retain heat. For better heat reflection from the unit to the pan, keep reflector pans or burner bowls shiny clean.

Always place a pan on a surface unit before turning on the source of heat. Turn off electric units a few minutes before cooking is completed; use the residual heat to complete the cooking process. Using retained heat is an especially important energy-conservation factor for glass-ceramic range tops.

Don't be a "peeker;" use a timer.

Oven Cooking

The efficiency of an oven depends on the amount of food cooked at one time. Baking one potato in a range oven would be poor use of energy, but using the oven to prepare a complete meal for a family would increase the efficiency of the oven considerably.

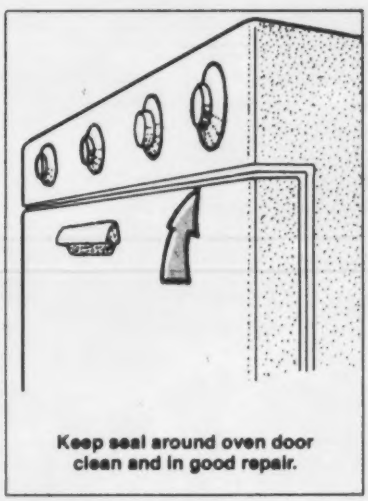
Shop and plan ahead for meals so that you can use the oven to prepare double or triple batches of food; refrigerate or freeze the extras for future meals. Defrost foods before cooking. Preheating the oven is unnecessary unless you are preparing foods that contain leavening agents. If you preheat the oven, put the food in to bake **as soon as** the oven is preheated.

Don't be a "peeker" when baking or roasting. Every time the door is opened, the oven temperature drops 25°–75°F (10°–40°C). The oven must then turn on to replace the heat that was lost. Make sure your oven thermostat is accurate and use a timer to tell when to check the food. Cure yourself of the "peeking" habit.

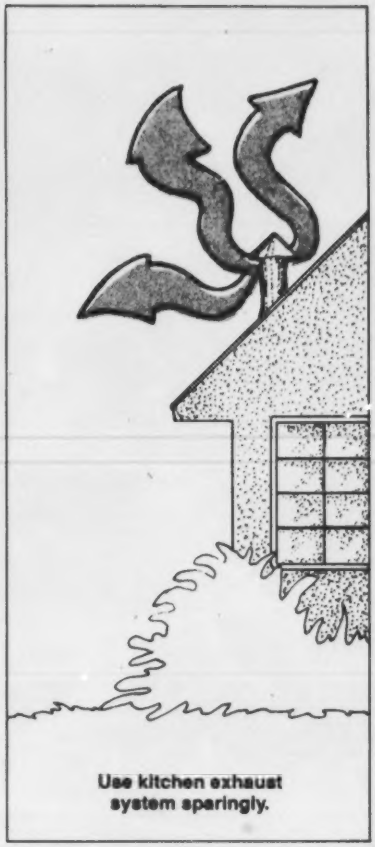
Glass and glass-ceramic cooking utensils absorb radiant heat well and allow oven cooking at temperatures 25°F (10°C) lower than levels required by metal cookware.

Periodically check and clean the seal around your oven door. A worn gasket allows heat to escape from the oven. Bake and roast carefully; clean spills and spatters before they bake onto the oven surface. This reduces cleaning time later on and saves energy if you have a self-cleaning oven.

Continuous-cleaning ovens require no extra energy; however, they do not clean as completely as self-cleaning ovens. Although a self-cleaning oven requires extra energy for the cleaning process, such a unit has more insulation and therefore retains heat better—for cooking and cleaning—than conventional models. To conserve energy, the self-cleaning feature should be used sparingly; and, to spread the demand for energy, clean the oven only during off-peak hours.



Keep seal around oven door clean and in good repair.



Use kitchen exhaust system sparingly.

Venting the Kitchen

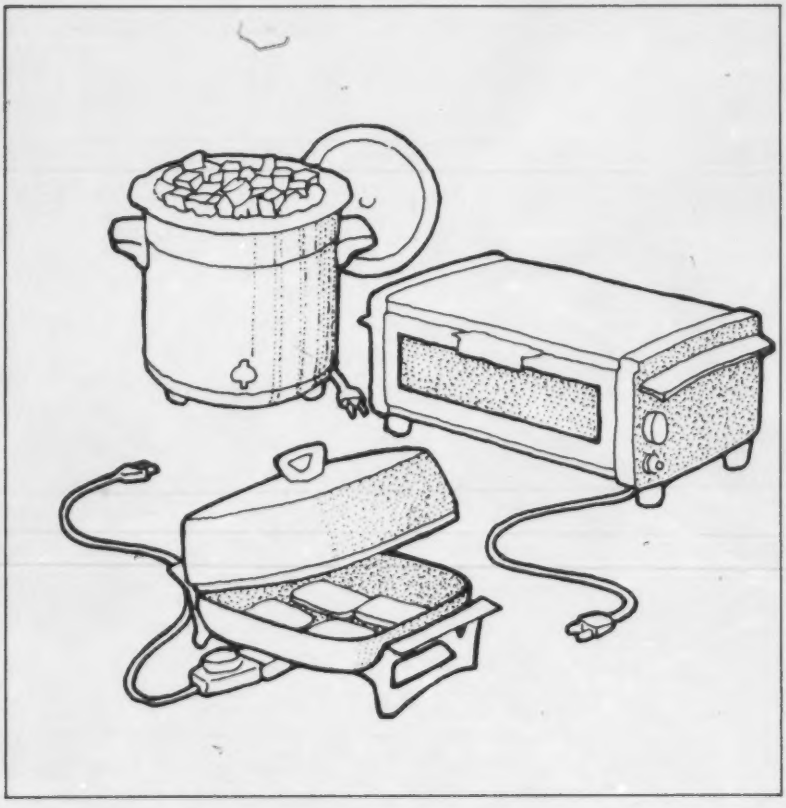
A kitchen exhaust system is often desirable to vent smoke, moisture, and odors. A fan or a range hood uses energy to operate. In addition, if the fan or hood is vented to the outdoors, conditioned air (heated in winter, cooled in summer) is also vented along with the odors and smoke. Additional energy must be used to heat or cool replacement air. Therefore, use a fan or range hood sparingly. In summer, open windows to provide natural ventilation instead of using the kitchen exhaust system. In winter, vent smoke and odors, but if possible, let excess moisture and heat pass into other areas of the home where they are needed.

Small and Special Cooking Appliances

Because small cooking appliances have enclosed heating elements, they often require less energy for a cooking job than an oven or surface unit of a range. Substitute small appliances for a range for some cooking jobs. An electric frypan is energy efficient and can be used for frying, baking, stewing, and broiling. For example, less energy is required to cook hamburgers on an electric frypan than on a surface unit of an electric range. Coffeemakers and egg cookers are similarly efficient. Toasters, toaster ovens, and small broilers use less energy than an oven, primarily because they are small and there is less metal to get hot. Table 6 on pages 50–51 will help you determine the energy used by small cooking appliances.

Another versatile and energy-efficient kitchen utensil is the pressure cooker. Because cooking under pressure is done at higher temperatures, foods cook in one-third the time of conventional cooking methods. Oven cooking in plastic bags and in aluminum foil also reduces cooking time and thus saves energy.

Whether microwave cooking is more energy efficient than conventional cooking methods depends on the quantity of food cooked, the length of cooking time, and the alternate method of cooking. A microwave oven is best used for preparation of a small number of food servings and for quick heating of foods.



FOOD PRESERVATION

Refrigerator-Freezers

The energy efficiency of a refrigerator-freezer is determined by overall size, insulation, method of defrosting, and freezer compartment location, size, and temperature. When you shop for a new refrigerator, select an appropriate size to serve household requirements and future needs. Too large a unit wastes energy as it cools unused space; too small a refrigerator necessitates extra shopping trips.

New forms of insulation are used to decrease the energy used in some refrigerators and freezers. To prevent the unit from "sweating" in hot, humid air, some new models use a heater to keep the outside walls from being too cold. A switch, to turn off the heater in winter, allows you to save energy and dollars. In other models, a part of the condenser tubing, called a post-condenser loop, is installed in the walls of the refrigerator to prevent them from getting too cold.

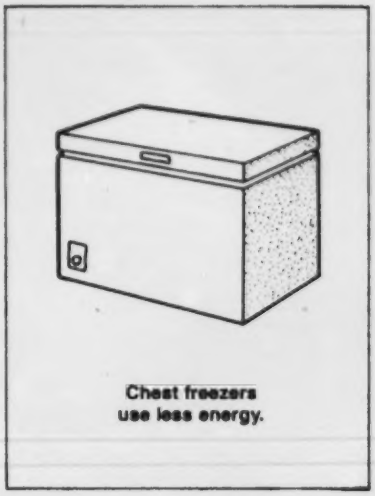
Compare the estimated energy consumption per month for various models of refrigerators. Manual defrost models use the least energy but require the most maintenance on your part. Cycle defrost models use more energy than manual models; they automatically defrost the fresh food compartment but require manual defrosting of the freezer compartment, though not necessarily as often as manual defrost models. Automatic defrost models use 55–60 percent more energy to operate than manual defrost models.

The freezer compartment of a refrigerator-freezer should be kept at 0°F (−19°C). The larger the freezer, the more energy required to maintain the temperature. A

freezer located at the top or bottom of a unit is likely to be smaller than that in a side-by-side refrigerator-freezer and will probably require less energy to operate. Significant savings in energy and dollars can be realized if you are willing to give up a few convenience features on a refrigerator-freezer!

All food stored in a refrigerator should be covered to prevent loss of moisture. Preventing foods from drying out not only preserves the quality of the food but also decreases the need for defrosting the refrigerator. Freezing food requires more energy than refrigerating it; therefore, if food will be used within a few days, store it in the refrigerator, not the freezer. When defrosting foods, such as a roast, place them in the fresh food section of the refrigerator so that, as they thaw, they can help cool the refrigerator.

The temperature of the fresh food section should be kept between 38° and 42°F (3°–6°C).



Chest freezers use less energy.

Colder than necessary settings waste energy. Check the temperature of your refrigerator by placing an outdoor thermometer in a glass of water on the middle shelf. Leave it there overnight. If the thermometer reading is not between 38° and 42°F (3°–6°C), adjust the temperature control.

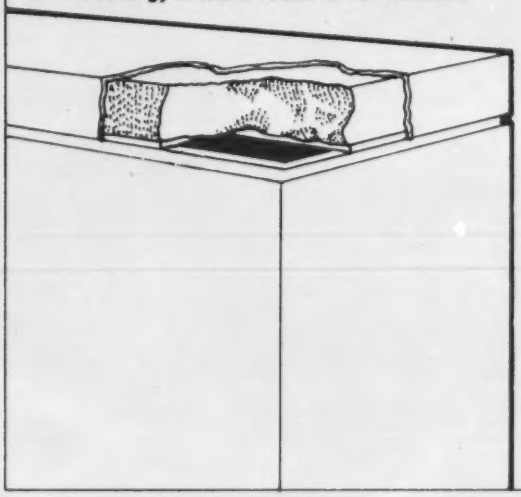
Freezers

A freezer is an expensive household appliance to operate. It must be maintained at 0°F (−18°C). If it is to pay its way, a freezer must be kept filled near capacity and the food rotated frequently. The cost of various defrosting methods, described in the refrigerator-freezer section, applies as well to freezers.

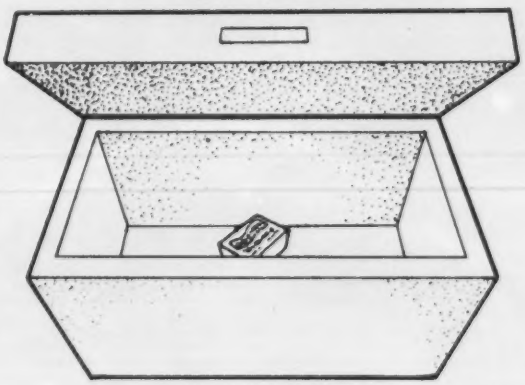
To minimize operating costs, select a well-insulated, energy-efficient unit. Because they lose less cold air when opened, chest-type freezers are usually more economical to operate than upright models. Buy food in quantity to minimize shopping trips. Cook and freeze in quantity. To protect its quality, food should be frozen quickly; therefore, do not overload the freezer with food to be frozen. No more than 3 pounds of food to be frozen should be added at one time per cubic foot of freezer space (50 kg per cubic meter).

If you raise and freeze much of

An energy-efficient freezer is well insulated.



Low freezer inventory reduces efficiency.



your own food, you need a lot of freezer space at harvest time but much less as the year progresses. Consider buying two small freezers instead of one large one. Stock both freezers at the end of the growing season. As your freezer inventory goes down, switch the contents of one unit to the other and disconnect the empty freezer until the next growing season.

Making ice is a high-energy operation. Use ice sparingly and do not waste it.

Refrigerator and Freezer Use and Maintenance

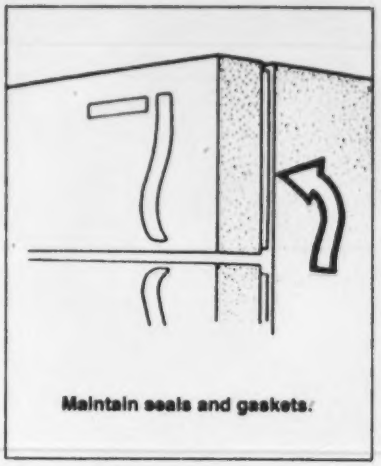
Try to reduce the number of times you open a refrigerator or freezer, especially in hot, humid weather. Unused portions of refrigerated food such as milk should be returned to the refrigerator as soon as possible. If you think ahead during meal preparation, you can remove and return several items at the same time and thus reduce the cooling load on the unit. Because bacteria grow rapidly in food held at room temperature, cool hot items for only a short time before refrigerating them. If a vacation or extended absence is planned, turn your refrigerator to a low setting; or empty, clean, and disconnect it, and leave the door ajar.

Defrost manual models when the frost is ¼" (6 mm) thick. Frost acts as insulation and reduces the efficiency of a refrigerator. Periodically check the door closure and gasket of your refrigerator and (or) freezer. Heat leaking in around the door causes a refrigerator or freezer to run a larger fraction of the time and thus waste energy. If a dollar bill pulls out easily when the door is closed on it, the door is not closing tightly. Either the gasket is worn and needs replacement, or more likely, the door is not closing properly. Make prompt repairs or have them done by a refrigerator service specialist.

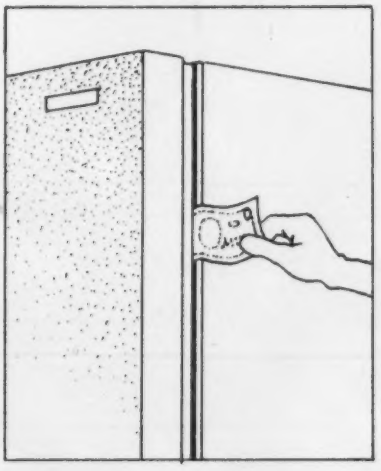
Keep refrigerators away from sources of heat.

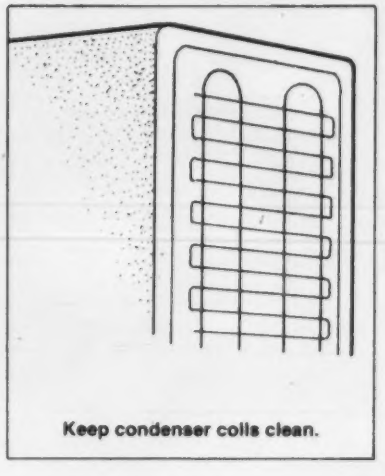
A built-in refrigerator or freezer may present a neat appearance; but unless the unit is designed to be built-in, restricted air circulation will cause the compressor to work overtime and use more energy. In addition to allowing for air circulation, the location of refrigerators and freezers should be away from heat sources such as ranges, heat registers, and direct sunlight.

Vacuum the motor housing and the condenser coils of refrigerators and freezers 3 or 4 times a year. Follow instructions in your owner's manual for other maintenance procedures.



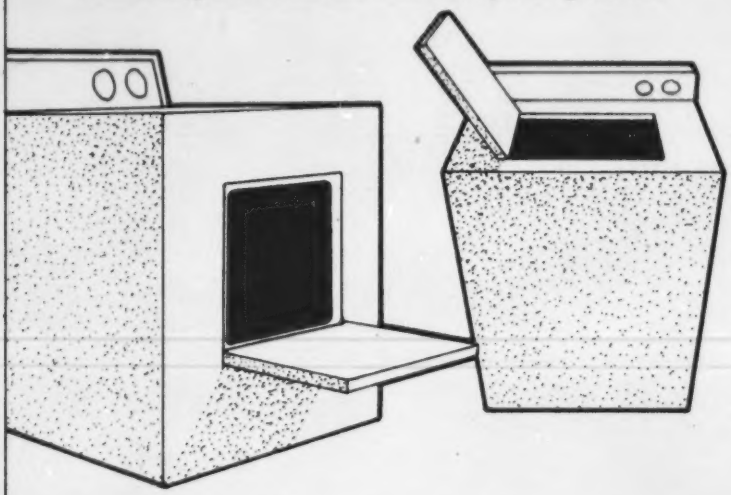
Maintain seals and gaskets.

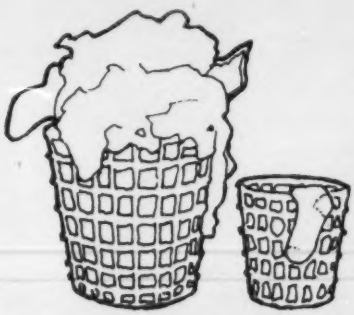




Keep condenser coils clean.

Front-loading washers use less water than top-loading washers.





Match amount of water use to size of load.

CLOTHES WASHING AND DRYING

Clothes Washing

The motor of a clothes washer uses a small amount of energy. The figure for the total energy used to wash clothes leaps, however, when the energy used for heating water is added. For the average household, water heating accounts for 15 percent of the total energy bill; a considerable portion of this is used for washing clothes. By using a machine that permits efficient use of hot water, you can save energy and dollars.

Front-opening, rotating-cylinder washers use less water than top-opening, agitator washers. Top-opening washers use from about 12 gallons (45 liters) of water to approximately 25 gallons (95 liters) each time they fill, depending on the size of the washer. If less than a complete fill is possible, match the amount of water used to the size of the clothes load.

Use as low a water temperature for the washing cycle as will give satisfactory cleaning. Take into account the fact that the temperature of water used on cold and medium water settings varies with the season. In the winter, the temperature of cold water may be 40°F (4°C) or below. Although more cleaning occurs in hot water than in warm or cold water, laboratory studies show that above 80°F (27°C) the increase in cleaning with temperature is small. Below 80° (27°C) cleaning drops. You may wish to use temperatures well above 80° (27°C) for clothes with a high bacteria count (diapers and clothing and linens of family members affected by infectious illnesses) or for heavily soiled clothes. If cool water is used for heavily soiled clothes, you may need to presoak them and use extra detergent.

Cold water should be used for rinsing. The temperature of rinse water has no effect on cleaning.

Check your owner's manual for instructions on maintenance such as cleaning lint filters, care of motor, and checking tightness of the belt.

Clothes Drying

Drying clothes on a clothes line uses no gas or electricity but makes heavy demands on human energy. Drying clothes outdoors may not always be practical, and indoor drying on a line or a rack may also present problems.

The alternative to line drying is an automatic clothes dryer. A dryer evaporates water from clothes. Water evaporation requires energy, large amounts of it, and energy costs money. Therefore, extract as much water as possible from the clothes before putting them in the dryer.

Sort dryer loads by fabric type. It is wasteful to run a dryer for one or two slightly damp items when the

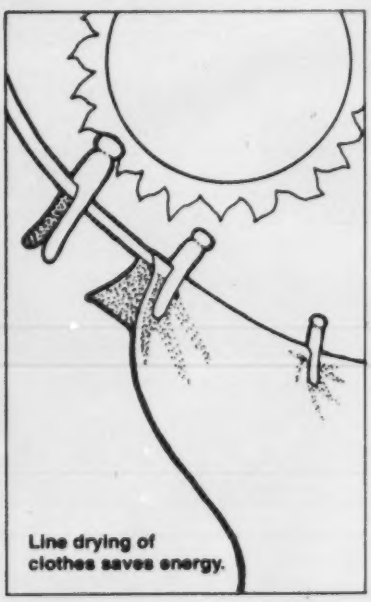
rest of the load is dry. A dryer with a variety of cycle settings allows you to set a temperature suitable for the fabrics being dried.

Tumbling clothes in a dryer helps to remove wrinkles and thus decreases the use of energy (human and electric) for ironing.

Permanent press fabrics absorb less water than conventional fabrics and therefore require less drying time. By using permanent press clothing and bed linens, you can reduce drying and ironing time and save energy.

Run only full dryer loads, but do not overload. An overloaded dryer takes longer to remove the moisture from clothes; this wastes energy. Also, clothes get heavily wrinkled when a dryer is overloaded.

Try reducing your "regular" drying cycle by 5 minutes or more; you may be overdrying clothes. Overdrying wastes energy and shortens the life of fabrics. Take advantage of residual dryer heat by running consecutive loads. Use your dryer during off-peak hours when energy demands on utilities are lower.



Line drying of clothes saves energy.

Clean a dryer's lint screen after each load. When drying very linty items, such as blankets, it may be necessary to clean the screen during the cycle. The outside vent should be checked and cleaned monthly; a clogged vent reduces efficiency. Follow maintenance instructions listed in your owner's manual.

If you have an electric dryer, you may be able to vent it indoors during the heating season to take advantage of moisture and waste heat. This technique is described on page 19. Gas dryers should be vented outdoors in all seasons.

DISHWASHING

Like a clothes washer, a dishwasher uses a very small amount of energy. Its main operating cost lies in the use of hot water. For efficient operation, a dishwasher requires 140°F (60°C) water. The high setting improves cleaning and sanitation, inhibits streaking and spotting, and provides best detergent action. Because the water temperature is 10°–20°F (6°–11°C) above that needed for other household tasks, you may want to consider installing a separate 20-gallon (75-liter) water heater near the dishwasher. This will permit you to lower the thermostat setting on your main water heater. Over time, the smaller heater will pay for itself in energy saved.

A dishwasher makes efficient use of energy and your time, but for the sake of energy conservation it is important to maximize its efficiency. Consider a unit with an energy-saving switch that automatically omits the use of heat during the drying cycle and thereby saves 20–40 percent of dishwasher operating costs. If your present dishwasher does not have an energy-saving switch, you can save the same amount of energy by turning off the unit and opening the door at the end of the rinse cycle.

Run only full loads in your dishwasher, preferably no more than one load per day, and that in the early morning or late evening when electricity demands are at a minimum. Scrape dishes well before placing them in the unit. Rinsing is seldom necessary; if it is, use cold water. Store soiled dishes in the dishwasher between meals. Measure detergent according to manufacturer's instructions. Too much or too little detergent reduces the efficiency of the unit. Use the shortest cycle that will clean the dishes. Clean the filter screen regularly and follow other maintenance instructions found in your owner's manual.

If you wash dishes by hand, try to cut down on the number of times you wash dishes each day and on the amount of hot water you use. Rinse breakfast and lunch dishes in cold water and stack them to be washed with dishes from the evening meal. Never let hot water run while washing dishes. If you have a double sink, fill both sides with hot water; use one side for washing, the other for rinsing. If you have a single sink, fill it with hot water for washing and use a pan filled with hot water for rinsing.

Table 6. Estimated annual kilowatthour consumption for selected electric appliances (1970)

Appliance	Average wattage*	Estimated kWh consumed annually
Food Preservation		
Food freezer (15 cu ft)	341	1,195
Refrigerator	250	750
Refrigerator-freezer (14 cu ft)	325	1,150
Refrigerator-freezer (frostless 14 cu ft)	350	1,400
Climate Control		
Air conditioner (room)	1,400	595
Dehumidifier	257	377
Fan (attic)	370	291
Fan (circulating)	88	43
Fan (furnace)	282	394
Fan (roll-about)	171	138
Heat lamp (infrared)	250	13
Heat pump	11,848	16,003
Heater (radiant)	1,322	176
Humidifier	177	163
Oil burner or stoker	266	410
Resistance heaters	15,000	17,000
Air conditioner (central)	5,000	2,500
Food Preparation		
Broiler	1,436	100
Carving knife	92	8
Coffee maker	894	106
Deep-fat fryer	1,448	83
Dishwasher	800	242
Food blender	386	15
Food mixer	127	13
Food waste disposer	445	30
Frying pan	1,196	186
Grill (sandwich)	1,161	33

Appliance	Average wattage*	Estimated kWh consumed annually
Hot plate	1,257	90
Range	—	1,175
Range self-cleaning oven	—	30
Roaster	1,333	205
Toaster	1,146	39
Waffle iron	1,116	22
Can opener	—	5
Home Entertainment		
Radio-phonograph	71	86
Television (black-and-white)	237	262
Television (color)	332	375
Laundry		
Clothes dryer	4,856	993
Iron (hand)	1,008	98
Washing machine (automatic)	260	78
Washing machine (nonautomatic)	195	59
Water Heaters	—	4,219
Illumination	—	340
Miscellaneous		
Clock	2	17
Floor polisher	305	15
Hair dryer	381	14
Heating pad	65	10
Sewing machine	75	11
Shaver	14	18
Sun lamp	279	16
Toothbrush	7	5
Vacuum cleaner	630	46
Bed covering	177	147
Water pump	460	231

SOURCE: Report of ad hoc Committee on Appliance and Apparatus Efficiency to the Interdepartmental Fuel and Energy Committee of the State of New York, June 25, 1973.

*The watt rating of a light bulb or an appliance indicates the rate at which it uses electricity. A 1,000-watt iron uses electricity 10 times as fast as a 100-watt light bulb. The wattage times the length of time the device is used tells the amount of electric energy used. A 100-watt light bulb used for 10 hours uses 1,000 watt hours or 1 kilowatt hour (kWH).

Electric bills are based on the number of kilowatt hours of electricity used. To determine the price you pay for electricity, you will need to check a full year's electricity bills. (Electricity use is seasonal.) Locate the column that tells you how many kWH of electricity you used that month. Go through a year's bills and total the figures. Divide the total amount you paid for electricity by the kWH figure to determine the average amount that you pay per kWH of electricity. The amount you pay per kWH will be lower for the months in which you use a lot of electricity. (Make adjustments for recent rate increases.)

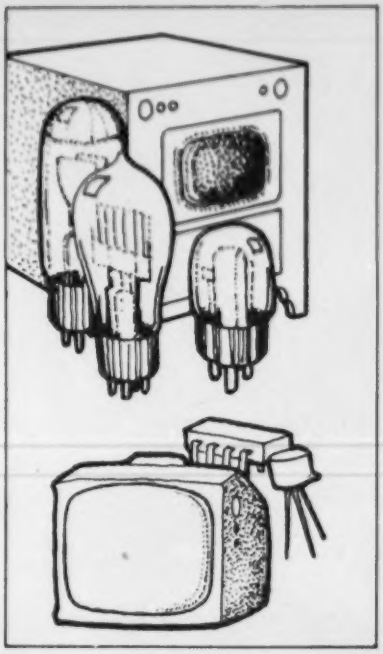
HOME ENTERTAINMENT

Home entertainment — televisions and television games, radios, record players, CB radios, and tape decks — is responsible for 3–4 percent of your total home energy bill. Entertainment is important and it's fun; it can also be energy efficient.

When you shop for home entertainment, seek out and buy solid-state equipment. Solid-state units use up to one-third less energy than conventional tube equipment. Solid state also means lower maintenance costs and longer life for a piece of equipment.

Often, a radio, record player, or television is left on when no one is listening or watching. That's not entertainment; that's wasting energy! Learn to turn off equipment when you leave a room. Teach children that part of the privilege of using home entertainment equipment is turning it off when they finish using it. If you find yourself "listening" to a television program that is also being broadcast on radio — a ballgame or political news conference, for example — switch to a small radio. Radios operate on one-sixth the energy of televisions.

When you purchase a television, buy as small a screen as you can tolerate. The smaller the screen, the less energy required to operate the television set. Also, black-and-white televisions use less energy than color sets. Many of today's televisions have an "instant on" feature which uses minute amounts of energy even when the screen is dark. Frequently turning the switch on and off may shorten the life of the equipment. The set should be disconnected if you plan to be away from home for an extended period of time.



SMALL APPLIANCES

Small appliances, including those used for cooking, often cost pennies a year to operate. Yet, if you count up the number of small electric appliances in your home — from a blender to a warming tray — you will readily see how, taken collectively, they account for 3–5 percent of your total energy bill. Thoughtful selection and use of small appliances are important. Before you buy, ask yourself these questions:

1. **Does the appliance make efficient use of energy?**
2. **Can you adapt another appliance or purchase a more versatile one to accomplish the task performed by the appliance you are considering? (It takes energy to manufacture the millions of specialized appliances sold annually in the United States.)**

When you purchase an appliance, look for efficiency, durability, repairability, and versatility. Use an appliance to save time and to save energy — yours and the nation's — but don't abuse the appliance or waste energy through thoughtlessness. Before you use an appliance, read its instruction booklet carefully. Keep all electrical cords in good repair and follow the manufacturer's maintenance recommendations. Table 6 on pages 50–51 will help you estimate the annual operating costs of small appliances.

The following tips, plus those included in the sections on food preparation and home entertainment, pages 45 and 52, will help you make energy-efficient use of your small appliances:

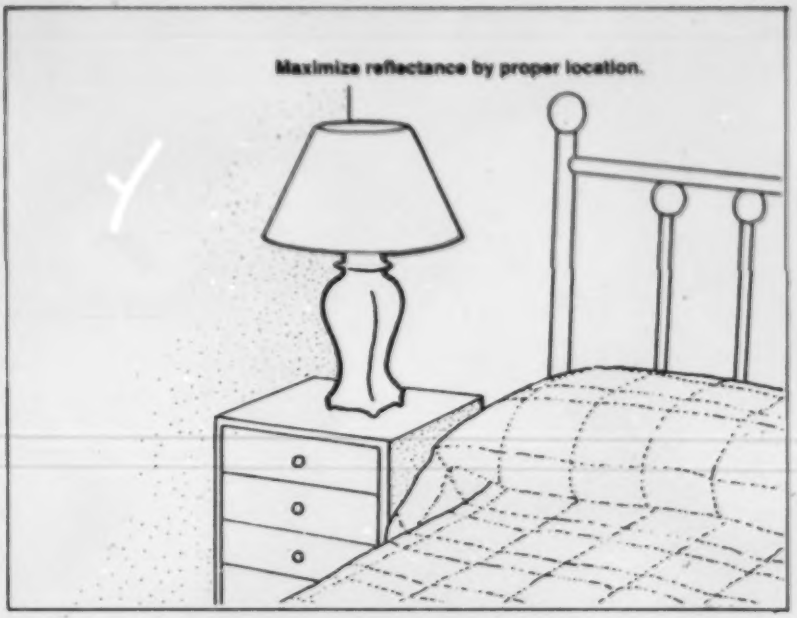
Irons. Iron clothes in large batches, working from low temperature settings to high. Turn off the iron when you have a few pieces left and use the residual heat to complete the job.

Hair dryers. To save energy, air-dry your hair whenever you can. When it is necessary to use an electric dryer, towel-dry your hair as much as possible before turning on the dryer.

Vacuum Cleaners. A good vacuum cleaner with a full set of attachments can do the work of a second cleaner, an electric broom, and a hand vacuum. Keep your cleaner efficient by emptying or replacing the bag as instructed by the manufacturer. Clean attachments after each use. On upright cleaners, check the belt and the length of bristles in the rotating brush to maintain the cleaner's efficiency.

EFFECTIVE AND EFFICIENT HOME LIGHTING

Through the wonder of electricity, we can literally turn night into day. The electric light, used for home decorating, safety, and security, is an essential part of our lives; but extravagant use far outstrips basic needs. Lighting amounts to 3.5 percent of a home's total energy bill and as much as 8 to 16 percent of the total electric bill. By using efficient lighting and by turning off unnecessary lights, it is possible to save energy and dollars.



Maximize reflectance by proper location.

Incandescent Lights

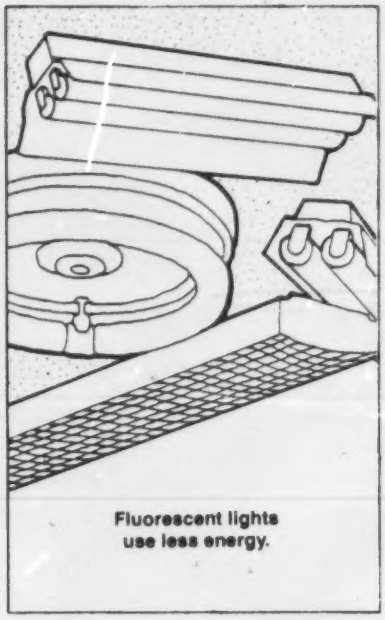
Light bulbs are measured in lumens (the light output) and watts (the rate at which bulbs consume electricity). In addition, packaging also indicates the average life of bulbs, usually 750 to 1,000 hours.

"Long-life" bulbs, which last an average of 2,500 hours, give off 20 percent less light per watt than standard bulbs. Long-life bulbs are not energy efficient; use them only in areas where it is difficult to replace bulbs, such as stairwells.

Low-wattage krypton gas-filled bulbs are now available in large electric supply stores. They come in 55-, 92-, and 138-watt sizes. These bulbs have lower wattage than standard bulbs that produce the same light (and therefore save energy), and they last longer, an average of 2,500 hours.

If higher illumination is required, consider using one high-wattage incandescent bulb instead of several of low wattage. For example, one 100-watt bulb produces approximately the same amount of light as two 60-watt bulbs, yet uses 20 percent less energy. For safety, do not leave live light sockets empty; fill them with burned out bulbs. Never use a higher-wattage bulb than specified for a fixture. Increased wattage may cause the fixture to overheat — a fire hazard — and shorten bulb life.

Concentrate light where you need it.



Fluorescent lights use less energy.

Fluorescent Lights

Fluorescent lights are 3 to 5 times more efficient than incandescent bulbs. One 40-watt fluorescent tube provides 3,200 lumens, whereas one standard 100-watt incandescent bulb provides 1,750 lumens. Fluorescent lights also generate less heat, a plus during summer months, and last 7 to 10 times longer. Use fluorescent lighting in the kitchen, bathroom(s), laundry, workshop, and recreation or family areas of your home. Fluorescent lighting can also be used effectively in valance and cove lighting in living and dining areas.

Efficient Use of Lighting

Concentrate light where you need it for work and study and in safety areas. Provide task lighting (preferably fluorescent) for desks, work benches, kitchen work areas, and sewing tables; general lighting in the room can be much lower. Recreation or large areas seldom require full illumination in all areas at one time. Install fixtures in a room on two or three circuits so that lighting in various parts of the room can be controlled by separate switches. Use solid-state dimmer switches in living, sleeping, and dining areas so that you can regulate lighting level according to activity. Whenever you turn down the light level, you save energy.

Maximize lighting by locating table, floor, and hanging lamps in corners where the light will reflect off two walls. Paint or paper walls and ceilings in light colors, and use light-colored draperies and shades. All will better reflect light back into a room.

Turning off lights **does** save energy; however, frequent switching on and off shortens the life of a bulb. Make it a practice to turn off incandescent lights if you are leaving a room for 3 minutes or more; turn off fluorescent lamps if you are leaving a room for 15 minutes. Teach children to follow your example. The turning off of lights will be made simpler and more certain if every room entry and exit is equipped with a wall switch.

Keep bulbs and reflectors clean.

Keep light bulbs, reflectors, shields, lampshades, and lamp chimneys shining clean. Dust and dirt absorb light and lower lighting efficiency as much as 50 percent.

Additional Lighting Tips

- **Use outside lighting for safety purposes only. Connect outdoor lights to a timer so that they do not burn continuously. Periodically adjust the timer to compensate for changes in the time of dawn and dusk.**
- **Do not leave lights burning continuously when you are away from home. Instead, connect a single light to a timer switch.**
- **Utilize the design of 3-way bulbs: high setting for reading and close work; medium and low settings for general room illumination.**
- **Take advantage of natural light. Trim shrubs and vines away from windows. During the winter, take advantage of solar light and heat by opening draperies during the day.**
- **Use light-colored lampshades with white liners. Effective lampshades are wide at the top and bottom, but are not too deep. Arrange lighting so that the bottom of a table lamp's shade is at the eye level of a seated adult, approximately 40" (1 m) from the floor.**

Save Energy Save Dollars

5

Furnish and decorate to conserve energy

Even if your home is adequately insulated, properly caulked and weather stripped, equipped with storm windows and storm doors, and your heating system properly cleaned and checked, you can still do some relatively simple and inexpensive things with furnishings to make sure you are getting the most from your energy dollar.

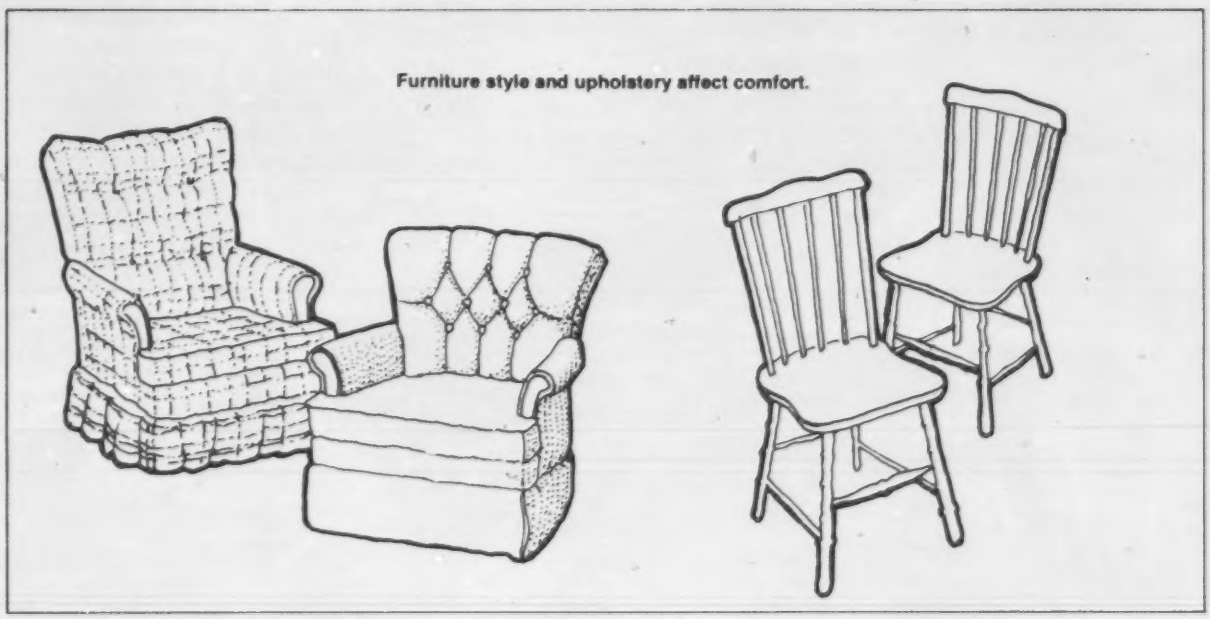
Furniture Placement

Place furniture far enough away from radiators, registers, and cold air return vents to permit easy circulation of heated or cooled air. You will also be more comfortable in winter if you keep furniture away from windows and outside walls, especially if they are not adequately insulated.

Radiator covers restrict the flow of heat; however, for aesthetic reasons, you may prefer to use them. At least 75 percent of the surface of a radiator cover should have grille openings to allow for more efficient heat flow. Keep covers clean, inside as well as outside.

Types of Furniture

Furniture style and upholstery affect comfort. Wing chairs are warmer than open arm chairs because they give protection from drafts. In winter, soft fabric upholstery feels warmer than leather, plastic, or wood. A warm-colored slipcover or furniture throw made of soft, fuzzy fabric can be used to cover unupholstered furniture in winter.



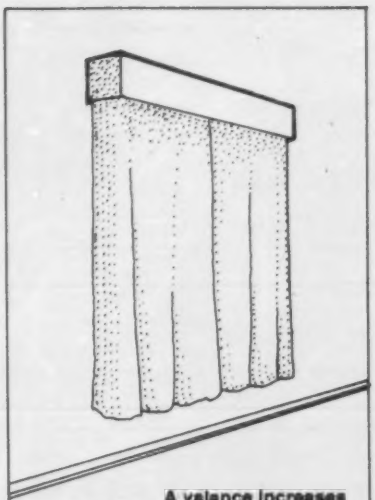
Furniture style and upholstery affect comfort.

This will add an insulative quality. In summer, furniture of leather, plastic, and wood, which are nonabsorbent materials, tends to feel "sticky" and adds to discomfort. Consider using slip-covers and furniture throws of smooth, absorbent fabrics. Colors such as blue and green will also make you feel cooler.

Carpeting

Carpets are warmer to the touch and offer more insulation than tile, wood, slate, or resilient floor coverings. Wall-to-wall carpets, laid over a cushion or pad, have greater insulating qualities than room-size or area rugs. Generally, the thicker and denser the carpet, the greater the insulation value. Wool and acrylic fibers provide the best insulation; nylon is the least effective.

Carpeting in the kitchen is a matter of personal choice; however, it is warmer than resilient or hard flooring. A good-quality kitchen carpet should consist entirely of man-made fibers. The face should be a nonabsorbent fiber, the backing water-resistant. For practical purposes, a multicolor or tweed carpet may be desirable.



A valance increases the effectiveness of draperies.

Window Treatments

Windows have considerable effect on heat loss in winter and heat gain in summer. In a recent study, it was found that the use of a light-colored opaque roller shade mounted inside the frame reduced heat loss through the window by 24 to 31 percent during the winter. In summer it could provide a savings of 21 cents of each air-conditioning dollar. The second best insulator, reducing heat flow approximately 21 percent, was lined glass-fiber draperies, sealed on the sides, top, and bottom, and pinned together at the center closure.

The method of draping a window has considerably more effect on heat flow than the fabric used. If your home has heat registers, draperies should hang at least 8" (20 cm) above the heat source, or metal deflectors can be used to direct heat into a room. For best efficiency with radiator or baseboard heat, draperies should hang a minimum of 4" (10 cm) above the heat source.

Since draperies are usually extended 3" (7.5 cm) from a wall, closed draperies can form a draft tunnel, with warm air being drawn over the top of the draperies and cooled on the glass, then flowing back into the room under the bottom of the draperies. One way to correct this situation is to construct a closed-top cornice or valance of wood or other material to fit over the top of the draperies. The drapery should be in contact with the valance and should be secured at the bottom.

During the winter, keep window coverings closed on overcast days. Open them on sunny days to take advantage of solar heat. To avoid heat build-up in summer, keep windows covered during the hottest hours of the day. Uncover and open windows after sunset to take advantage of the cooler night air.

Use of Color

Light colors reflect light; dark colors absorb it. If you paint or paper walls in light colors, you will find you need less illumination in a room. Consider painting ceilings in lighter tones than walls so that light will be reflected back into a room.

Warm colors such as reds, pinks, and oranges add psychological warmth to a room. Colors such as blue and green tend to make a room "feel" cool. If you want to change color schemes when you redecorate, consider using warm colors for rooms with northern exposures and cool colors for rooms with a heavy western exposure. Slipcovers, furniture throws, and accessories can be varied with the season to give a room a feeling of warmth or coolness.

Save Energy Save Dollars

6

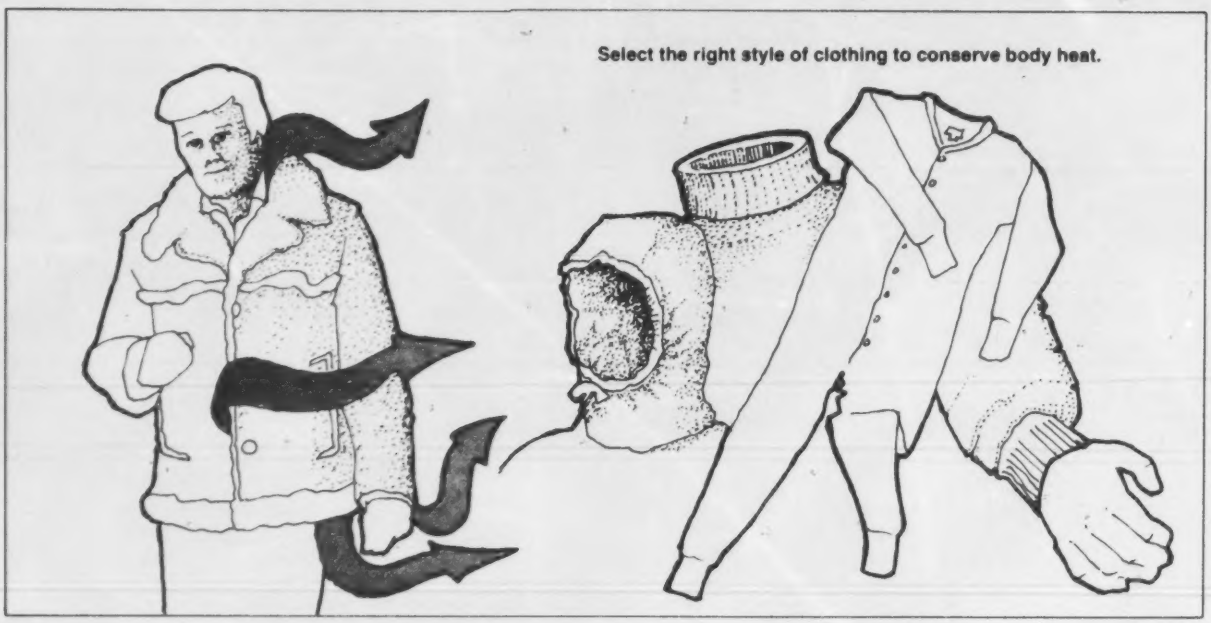
Winterize your wardrobe

Keeping warm in cold climates is what clothes are all about. They are the principal means of keeping body heat in and cold air out. Learning how to build an efficient cold-barrier is your key to effective winter clothing.

The old adage, "If your feet are cold, put on your hat," provides good advice. Up to one-fourth of the heat generated by the body is lost from the head area. Blood supplies to the head are always maintained, for it is essential that the brain be nourished. When the head is covered, the heat saved can be redirected to other parts of the body such as cold feet and hands. To keep your head warm, wear a wig, scarf, or a woolly hat, indoors and outdoors.

The central mass of the body, the trunk, or torso, is the site of the major vital organs; they must be maintained at the proper temperature. In cold environments, the body conserves heat by reducing the blood supply to the body surface and to the hands and feet. When this occurs, you feel cold. Selecting the right type and amount of clothing to keep the torso warm is very important.

Clothing acts by trapping a layer of air next to the skin, greatly reducing loss of body heat. With the addition of each layer of clothing, more air is trapped, and the body feels warmer. When too much clothing is added and during physical activity, the body perspires in an attempt to become cooler. If the moisture produced is allowed to collect in clothing,



Select the right style of clothing to conserve body heat.

insulating capacity will be lowered considerably, and you may feel cold and clammy.

Belts and drawstrings at the waistline prevent clothing from billowing out and letting cold air in. Ribbed cuffs at the neckline, wrists, and ankles also retard air infiltration.

The layered look of today's fashion provides a good opportunity to maintain a comfortable level of body heat. By wearing shirts, blouses, sweaters, and jackets in different combinations, it is easy to match the amount of clothing worn to the surrounding temperature by adding and subtracting different layers. Don't add so many layers that movement is uncomfortably impaired. Opening collars, rolling up sleeves, or removing scarves or cardigans vents warm, moisture-laden air and prevents perspiration from building up in clothing.

Surprisingly, no one fiber is warmer than another. What is important is the thickness of the fabric. Wool and woollike synthetics such as acrylics, nylons, and polyesters can be equally warm if of similar thickness and construction. If a thick fabric becomes matted into a thin one through improper care, however, it will be less warm. Thick, fuzzy sweaters are warmer than thin, smooth ones; but neither are much good on a windy day because the wind will release the layer of warm air trapped by porous clothing. Outerwear of tightly woven fabric will cut the wind and, if combined with a thick, padded, or deep-pile lining, will keep warm air trapped next to the body under all but the most severe conditions.

Many pieces of innerwear are reappearing from the past. Such things as vests, long johns, bed jackets, and elbow and knee warmers are available in many materials. Particularly good are thermal knit fabrics. They are waffle-like in structure and are designed to trap and hold in body heat.

Windbreakers and sweaters trap body heat.

The extremities, arms, legs, hands, and feet, must also be well protected. For example, slacks or pants worn over panty hose or loose-fitting leotards provide greater warmth than a skirt and thin nylon hose. Long, fuzzy, woollike socks are more comfortable than smooth, thin ones because they entrap more air and absorb moisture from the feet. Feet can be insulated from cold floors by wearing thick socks and loose-fitting slippers. Try mittens instead of gloves if your hands get cold easily.

If you're cold at night, try wearing long-sleeved pajamas or a nightgown of napped or brushed fabric. You might even want to return to the old-fashioned idea of wearing bed socks or using a hot-water bottle to keep your feet warm.

Make your clothes work for you. Strive for your particular comfort level — everyone's is different. By learning how to combine and select fabric thickness and adjust clothing layers, your clothing can effectively and economically meet your body needs in the various environments in which you work and play.

7

Landscape to save energy

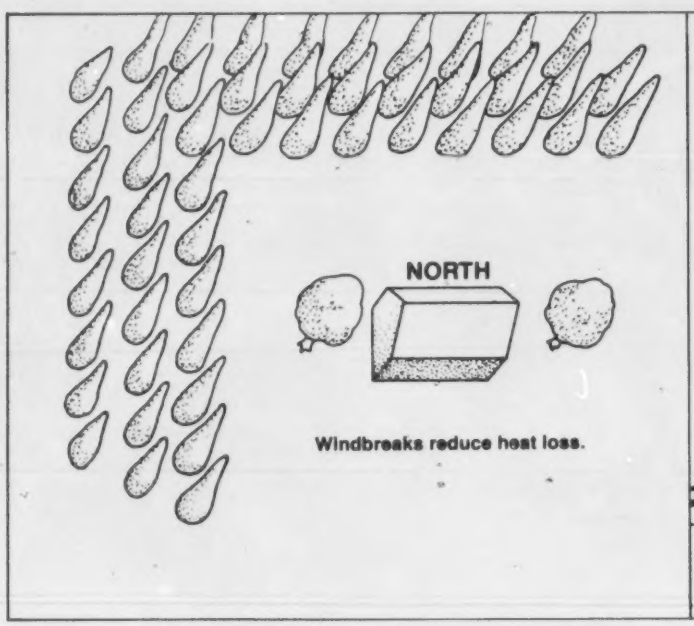
Trees and shrubs add not only attractiveness to a homesite, but also help to reduce heating and cooling requirements. Evergreen trees and shrubs can protect a home from winter winds. Deciduous trees — those which drop their leaves in the fall — can shade a home from sunlight in summer but allow the sun's rays to warm a home in winter. Both types of trees, if properly planted, can also help to reduce noise and dust pollution.

Trees and shrubs are investments; therefore they should be selected and planted with care.

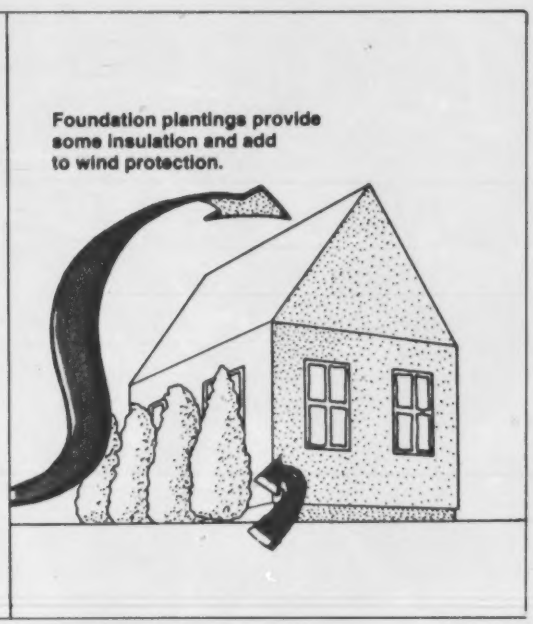
Windbreaks

Cold, north winds can cause large amounts of heat to be lost from a home in winter. A windbreak of evergreen trees reduces heat loss considerably and thus helps you to save fuel.

Plant a windbreak in an L shape, with the arms of the L extending around the north and west sides of the area to be protected. An effective plan for a large lot would be to plant three rows of evergreens 14′ (4.2 m) apart. Within the rows, the trees should also be spaced 14′ (4.2 m) apart. The middle row should be spaced opposite the openings of the other two rows. The ends of the windbreak should extend 50′ (15 m) beyond the end of the area to be protected. To minimize drifting snow, site the planting at least 50′ (15 m) from the home or driveway. Choose trees 2′ to 4′ (0.6 m to 1.2 m) tall; they will readily establish



Windbreaks reduce heat loss.



Foundation plantings provide some insulation and add to wind protection.

themselves and will soon provide an effective windbreak. For a smaller lot, use two rows of trees planted alternately.

A windbreak is effective over a distance 8 times its height. For example, a dense planting of evergreens, 10′ (3 m) tall, will check the wind 80′ (24 m) to the lee or house side of the windbreak.

Hemlock, fir, and spruce make effective windbreaks. Pine is not as desirable because, once matured, the boughs do not grow at ground level; thus the effectiveness of the windbreak is lessened considerably.

Smaller evergreens planted next to a foundation wall create dead air space between the wall and the plants and thus provide some insulation in addition to wind protection. Such a planting must be dense and form a solid wall in order to be effective. In northern climates, Japanese yew is a good choice for foundation windbreak plantings.

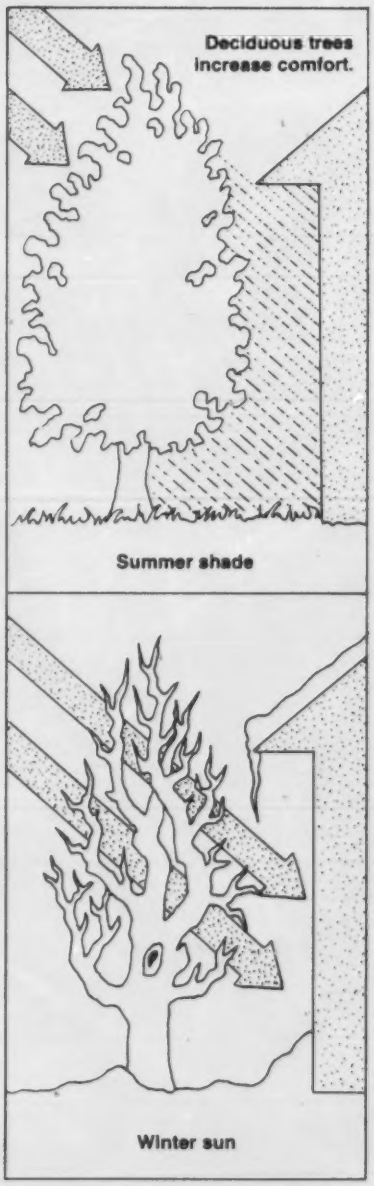
In addition to providing winter wind protection, evergreen trees and shrubs planted on the north and west sides of a site direct cooling breezes around the home in summer.

Until a planting of evergreens becomes established, or if your lot size does not permit an effective planting, a tall fence will provide a satisfactory though less natural windbreak.

Shade Trees

Deciduous or hardwood trees can add immeasurable comfort to your home in summer. Their shade lessens the need for air conditioning and fans and thus cuts down on energy expenses.

Shade trees on the west and east sides of a home block the sun's rays before they reach windows. Though shades and draperies can be used for this purpose, shade trees have been shown to be 7 times more effective. During the winter, the bare branches of hardwood trees allow sunlight to filter through to the home where some benefits of solar heat can be realized.



To determine the amount of shade a tree will give, hold a very tall pole on the selected planting site and note the shadow it casts. Move the pole around the area to get some idea of other effects of the proposed tree's shadow. Plant the tree in the spot that will give you the most shade. The shade from the tree should extend over the house to prevent summer heat build-up in the attic area.

Norway, red, and sugar maples; red and pin oaks; and little leaf European linden are good choices for shade trees in the Northeast where winters are often severe. Because they are weak wooded and (or) short lived, willow, box elder, silver maple, and poplar should be avoided.

Do not plant evergreens for shade. Evergreens have no canopy to protect a home from summer sun, and they block sunlight from a structure in winter when solar heat is desirable.

Vines

Deciduous vines that can be trained to grow flat against walls or trellises can be planted on the south side of a structure. These woody vines absorb and reflect the sun's rays in summer but, because they lose their leaves in fall, allow sunlight to warm a home during winter months. Wisteria, bittersweet, and Boston ivy are good choices for northern climates. Avoid evergreen varieties such as English ivy; they block the sun in winter.

Your county Cooperative Extension agent or a professional nursery operator can advise you on the care of trees, shrubs, and vines and on the selection of plantings for your particular homesite.

8

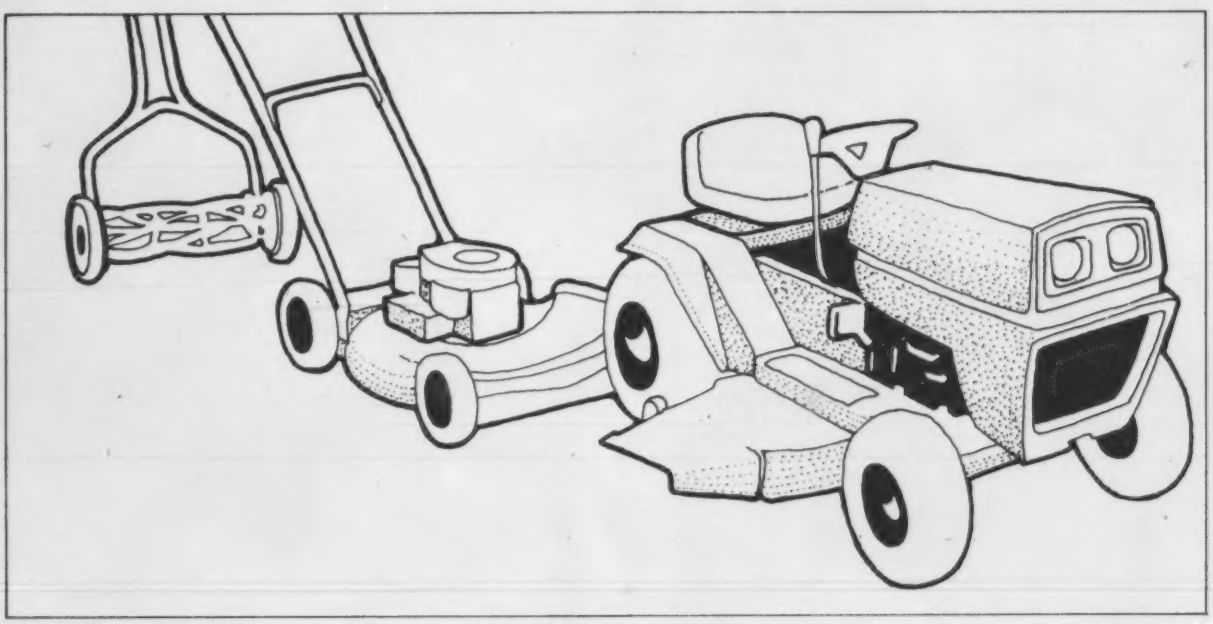
Power tools and lawn equipment

Power tools are time-savers for do-it-yourselfers; many jobs would be next to impossible to complete without them. But the energy-conscious person uses power tools only as much as is necessary. Handtools are the mainstay of an energy-efficient workbench or tool room.

When purchasing a power tool, buy one with the lowest horsepower (watts) adequate for the work you want to do. Extra horsepower means extra energy is needed for operation. Clean electric tools after each use and lubricate them regularly. Keep all electric cords in good repair. It is important to keep cutting edges sharp: a sharp bit or blade cuts quickly and, therefore, uses less energy. Turn off power equipment such as soldering irons as soon as you have finished using it.

In the yard and garden, use hand equipment, when feasible, to save energy — and to get physical exercise! When it is necessary to use power equipment, get the most efficient use from it by keeping it in good repair: keep blades sharp on mowers and clippers and follow the manufacturer's recommended maintenance program for lawn mowers and garden tractors. Don't allow gasoline-powered equipment to idle for any length of time; that wastes energy.

Consider using wood ashes (where appropriate) or natural compost for fertilizer in your garden. Don't overuse chemical fertilizers or pesticides; they require considerable energy to produce.



9

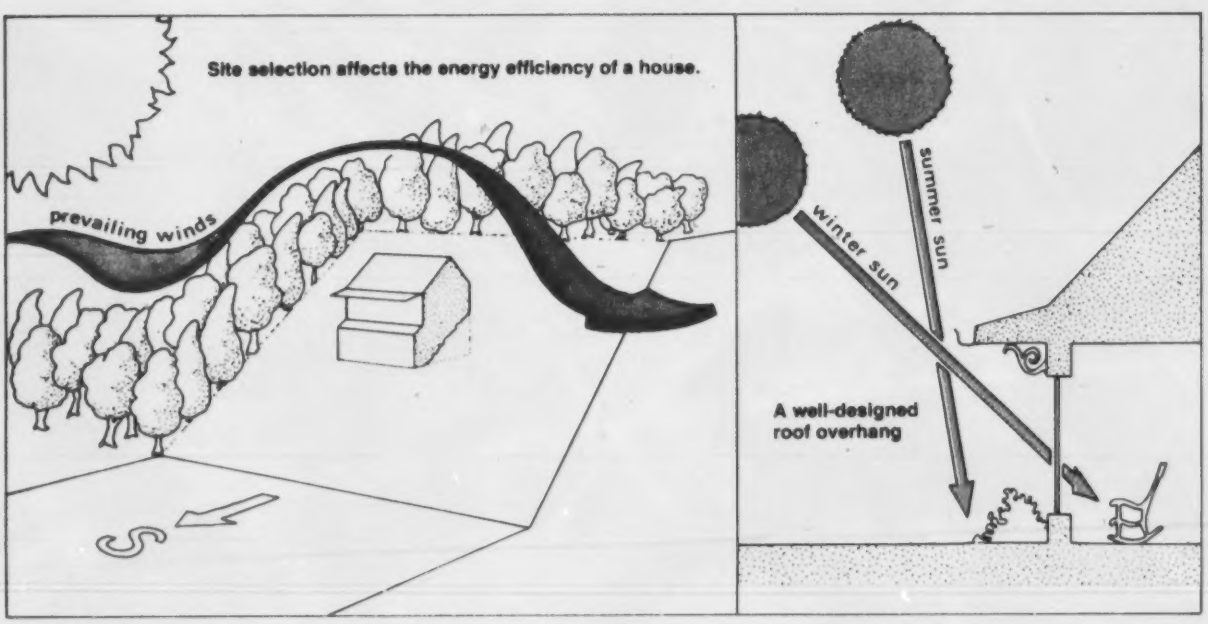
Build and remodel for energy efficiency

Many opportunities to conserve energy are present when you build, add to, or remodel a house. Be mindful that when a house or addition is in the planning stage, decisions are critical and essentially seal the fate of many conservation techniques.

Energy-saving measures taken when a house is under construction often add to building costs, but benefits will be realized in increased comfort and lower operating costs. If new furniture or appliances, a patio, built-ins, or other extra features are part of your building plans, let them wait and use the money to make the house or addition as energy efficient as possible from the start. A home planned and constructed for maximum energy conservation could easily reduce energy use by 50 percent over an existing, standard type house. In simple terms, this means that if heating costs for a standard 3- or 4-bedroom house run $600–$800 per year, potential annual savings of $300–$400 or more could be realized if proper attention and care are paid to energy conservation during construction. The extras you put off for the sake of energy conservation will soon be affordable.

Site Selection

If you are able to select a building site for a new home, there are a number of energy factors to be considered. For instance, a house located on the southern slope of a hill reaps maximum benefit from the sun. Additional advantage from



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the southern slope can be gained by building the house into the hill. The soil will act as good insulation to cold, above-ground temperatures.

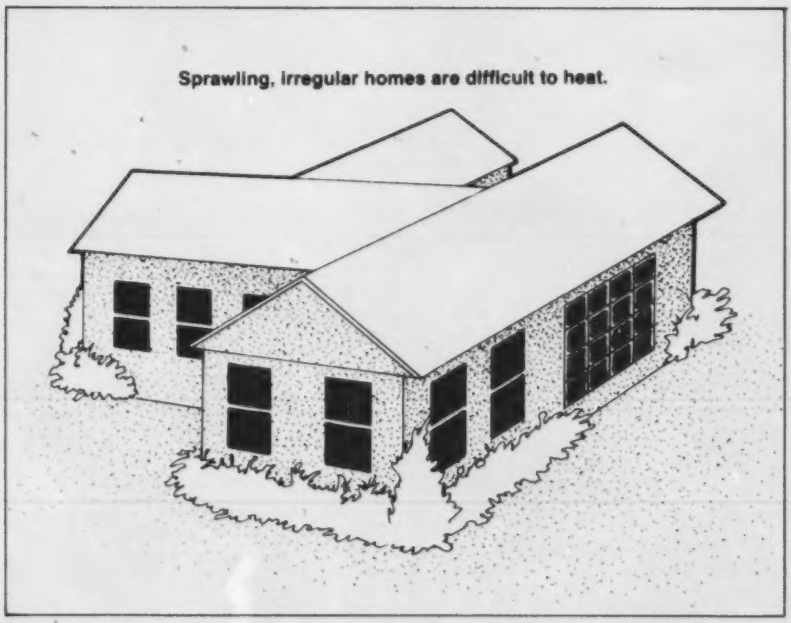
On the other hand, if the site involves woods, locate the house so that wooded areas come within a reasonable distance of the east, west, and north sides. The woods will provide a windbreak and help reduce heat loss. Open the southern exposure so that you can take advantage of solar heat.

If your site has neither trees nor hills, read through the manual section on landscaping, pages 59–60, and incorporate full plantings of trees and shrubs into your building plans.

Orientation

The orientation of a house to sun and wind affects energy efficiency. The southern exposure should incorporate as many features as possible to maximize the benefits of solar heat. Leave the southern exposure open, especially if you have any plans to use a solar collector in the future. A well-designed roof overhang can protect a southern wall from summer sun, yet allow the wall to be warmed in winter when the sun travels in a lower arc across southern skies. Deciduous vines, seasonal awnings, shutters, and an extended porch can also help protect and take advantage of the southern exposure.

Northern and western exposures should be kept minimal and should be protected from prevailing winds through landscaping or fences. Direct afternoon sun in the summer can be troublesome; so plan to shade the western wall with deciduous trees. In fall and winter, the bare branches of the trees will allow sunlight to reach the wall and warm it.



Sprawling, irregular homes are difficult to heat.

Design

Before you begin to draw up a building plan, make a careful projection of your space requirements. Build large enough to meet your needs, but no more. The larger the house, the more energy required to heat it.

A simple rule governs overall energy-efficient design: Construct a house or addition with a minimum of outside surface exposed. A square floor plan provides the least exterior surface and therefore suffers less heat loss in winter than an oblong or spread-out design. A two-story house, or one with the lower level built partially below ground, will cost less to operate per square foot (square meter) than a sprawling, one-story ranch.

Plan living space for the southern and eastern portions of the home and sleeping areas for the northern side. Orient "hot" rooms—kitchen and laundry—away from the western exposure.

In northern climates, a dark roof is usually preferable to a light-colored one because the dark color absorbs more heat and thus keeps the attic space a little warmer during winter months. However, if your homesite is subject to large summer cooling loads, there is an advantage in having a light-colored roof which will reflect the sun's heat.

Windows and Doors

The number, size, and location of windows and doors do much to determine energy consumption in a house. Because glass is a poor insulator, walls of windows do not belong in a house or addition built with energy efficiency in mind.

Decide on the minimum number of windows you can tolerate, and be reasonable about size. Use carefully fitted double- (thermopane) or even triple-glazed windows throughout the house or addition. Install windows you can open for natural ventilation in mild weather.

A double entrance conserves heat.

The north-south factor is important here, too. Plan more windows on the south side of the house or addition so that you can take advantage of sunshine. Install as few windows as possible on the north wall; no solar heat gain can be realized there. Be prepared to shield windows with draperies, blinds, or shades, especially on the west side of the house. The section of the manual on home decorating (pages 55–56) can help you make energy-efficient choices.

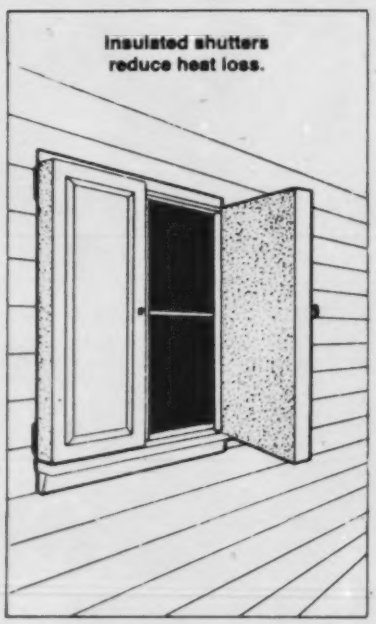
For additional insulation, plan on installing storm windows when you build, or consider using shutters made from insulating materials such as urethane, polystyrene, or styrofoam. Close the shutters at night and when a room is not in use.

Plan entrances so that they will be protected from winter winds. For frequently used entrances, plan on double doors, separated in such a way that the outside doors can be closed before opening the inner doors. A vestibule or entrance through an attached garage will serve this end. Insulated doors should be used and protected by storm doors.

Sliding glass doors are not good from an energy standpoint; however, this option may be important to you. If sliding glass doors must be used, be certain the glass is double thickness and select the smallest size door to meet your needs. Wood frames around glass doors are better insulators than aluminum. In winter, cover glass doors with insulated draperies.

Plan doors to separate interior areas of the house and use them. You can then more effectively concentrate heat in areas where you need it and lower temperatures in less active areas of the home.

If your family has pets, you may want to consider an entry door for them so that a main door doesn't have to be opened each time they want to go out or come in. Such doors can be built into walls or main doors.



Insulated shutters reduce heat loss.

Insulation

Spend every penny you can afford to achieve maximum insulation during construction. It will never be easier to insulate than when walls and ceilings are open. Read the sections on insulation, pages 16–27, and follow all recommendations. Don't skimp! At current fuel costs, the use of R-19 insulation in ceilings and R-11 in sidewalls is essential.

There is a trend toward changing wall construction to allow for greater thickness. The use of 2″ × 6″ wall studs on 24″ (60 cm) centers allows for a 5½″ (14 cm) sidewall with very little additional lumber required. This allows for extra sidewall insulation.

Be an insulation stuffer during construction. Stuff insulation into every possible opening and crack, especially around windows, doors, corners, and electrical boxes and wiring. The extra time taken to fill all cracks with insulation will be repaid many times over the years.

Rigid plastic insulation materials can be used under the siding on outside surfaces. This adds insulation and reduces heat loss caused by air infiltration. With this type of insulation, it is very important to have a good vapor barrier on the inside of the wall; carefully installed polyethylene is recommended. Unless covered with fire-resistant gypsum board or its equivalent, rigid plastic insulation is not recommended for interior walls.

The foundation should not be overlooked when installing insulation. A compressible filler applied to the top of the foundation before the sill plate is fastened will retard air infiltration.

Heating System

After a basic design is determined, your architect or heating contractor can plan the most efficient heating system for your new house or addition. The equipment should be no larger than necessary. If you follow the energy conservation measures recommended in this section, the equipment can probably be reduced in size, and therefore, your operating costs will be lower.

Because of energy shortages, electric resistance heating is being used in many new homes. If electricity is your only option, you may want to consider using a heat pump. Heat pumps are described in some detail on page 29.

It is recommended that those planning new construction install and insulate ductwork for central heating even though wallboard resistant heating is planned for the present. This will offer more options in the future for switching to alternative heating systems such as solar energy or a heat pump.

Locate your furnace centrally so that heat is not lost between the furnace and the area you are trying to heat. Read the sections on heating equipment, pages 27–30, and thermostats, pages 30–31, for other energy conservation tips.

Try to locate the chimney so that it runs through instead of outside the house. Then you, rather than the outdoors, can benefit from the heat it radiates. An interior chimney requires very careful construction.

Water Heating

Install the water heater as close as possible to areas of major use and cover all water pipes with insulation. Use small diameter pipes for hot water lines to reduce standby losses. Additional information on water heating can be found on pages 37–40.

Lighting

Forethought and planning can reduce lighting requirements considerably. If you use light colors for interior decoration, you will find you need less illumination. Paint ceilings in lighter tones than walls so that light will be reflected back into a room. Fluorescent lighting is 3–5 times more efficient than incandescent lighting and should be used wherever possible.

You will be more apt to turn off lights as you leave a room if each doorway is equipped with a switch. Dimmer switches allow you to adjust lighting to suit the activity in a room; use them in living, dining, and bedroom areas.

Energy efficiency in lighting is covered in more detail on pages 53–54.

Kitchens and Bathrooms

The two areas most commonly remodeled or updated in older homes are kitchens and bathrooms. The energy conservation measures available to you depend on the extent of your remodeling plans. If you plan a total renovation of a kitchen or bathroom, follow the general guidelines outlined in this manual section. If your plans are more modest, follow as many of the guidelines as possible. The following recommendations will also help you conserve energy.

When building from scratch, locate the kitchen and laundry away from the west side of the house. If this is not possible in an existing house, incorporate exterior shading into your building plans.

To avoid running extra water lines, try to back up bathroom and kitchen plumbing on the same wall. When renovating, relocate plumbing lines away from outside walls and cover the lines with pipe insulation.

Exhaust fans are useful in kitchens and bathrooms. Use them sparingly in winter when humidity levels are low and only as needed in summer. A kitchen exhaust fan should be vented to the outdoors and should be self-closing. Locate the fan 30" (75 cm) above working height. In a bathroom, the exhaust fan should be located just outside the tub or shower area and the control switch placed away from water sources. A vent in a bathroom with no windows is essential. A louvered door will also help ventilate excess moisture from a bathroom.

When remodeling or building a bathroom, consider installing in the ceiling a radiant heating fixture connected to a timer to provide energy-efficient heat after bathing.

Read through the manual sections on humidity, pages 18–19; water heating, pages 37–40; ventilation, pages 20–22; and appliances, pages 41–52, before undertaking a kitchen or bathroom remodeling or building program.

10

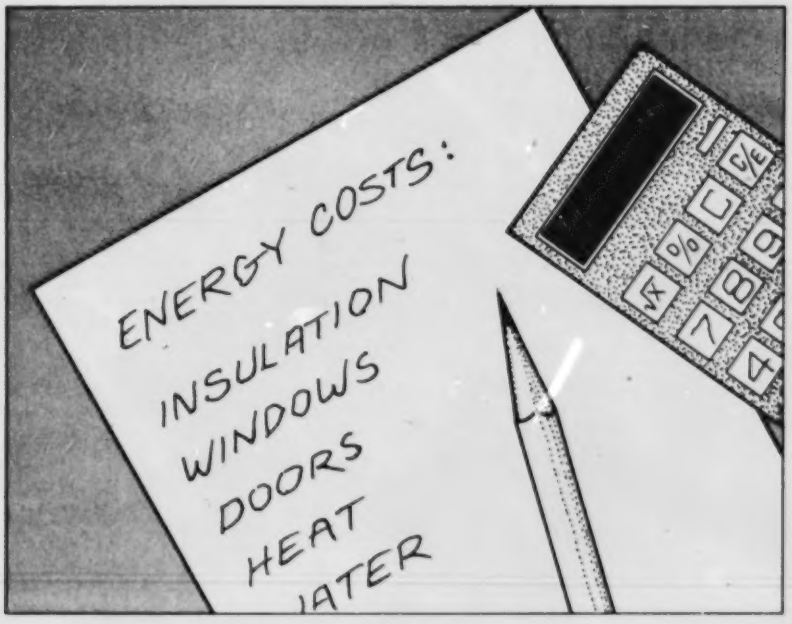
Be energy conscious when you buy a house

Energy efficiency should rank near the top of your "want" list when you purchase a new home. Before you survey the housing market, consider the size and amount of essential living space you require. Buy a home no larger than you need.

Each house you consider should be looked at carefully not only in terms of price, location, and view, but also in light of its operating and maintenance costs. Read through the sections of this manual on insulation, heating equipment—space and water—storm windows and storm doors, landscaping, and the sections on orientation and design in the chapter on building and remodeling. The "Energy Management Checklist," pages 91–93, will also be helpful. Familiarize yourself with basic data and jot down energy questions to ask about each home you look at.

Ask to see the previous year's heating bills and make adjustments for current rates. Ask for a description of the insulation in the house and check where you can to verify the amounts stated. Check information on the efficiency of the space and water heating equipment—and cooling equipment, if that's included. If the information is not available or is sketchy, hire a professional engineer or a heating and cooling contractor to make an energy-efficiency evaluation for you.

If insulation is needed or if basic equipment needs replacement, lower your purchase offer and use the difference to cover the costs of making improvements. If this is not acceptable, make a lower downpayment and use the difference for improvements. If neither of these alternatives is viable, keep shopping until you find an energy-efficient house or one you can afford to make energy efficient. You will reap dividends over the years in energy and dollars saved.



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"How can I conserve energy? I'm concerned (I drive an energy-efficient car), but I live in an apartment. Isn't energy conservation the responsibility of the building owner?" These questions represent the feelings of many apartment occupants.

The response? Yes, many energy conservation measures — storm windows and storm doors, insulation, separate meters, and thermostats, for example — are the responsibility of the building owner. But there is much you, the tenant, can do by becoming an energy advocate and by making efficient use of energy in your apartment.

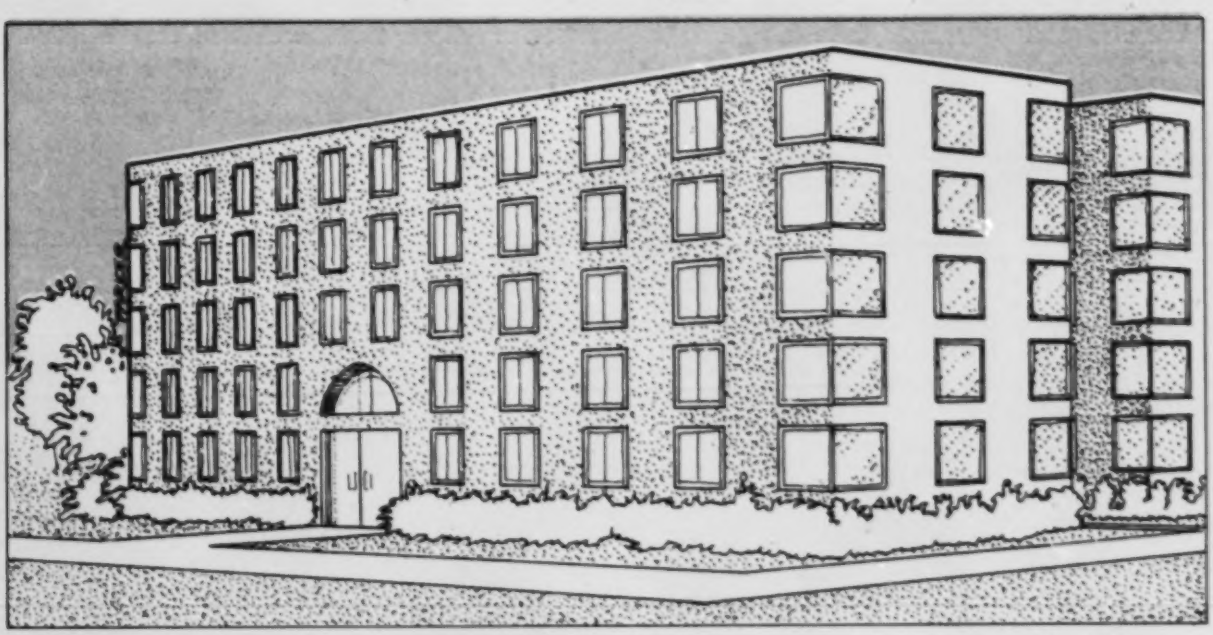
Your Role as Energy Advocate

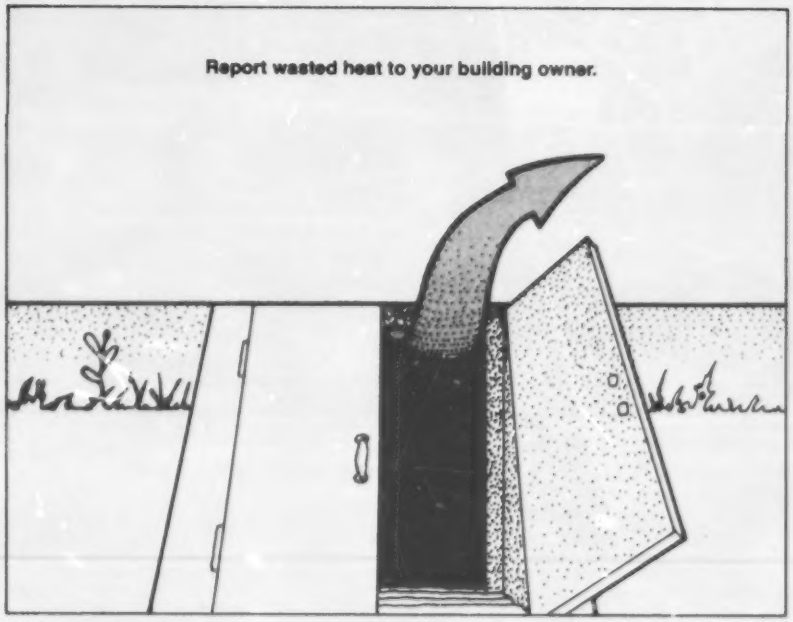
The most important thing you can do as an apartment-occupant–energy-advocate is to convey to the owner of your building your sentiments about the need to conserve our limited energy resources. In person or by letter, point out how energy is being wasted in your building.

Are there drafts around windows and doors? Ask the building owner to weather-strip windows and doors and to fill cracks with caulking compound. Also ask the owner to consider installing storm windows and storm doors if there are none on the building. (4- or 6-mil plastic sheeting is an inexpensive but effective substitute for glass.) The combination of weather stripping, caulking, and storm windows and storm doors

11

Conserve energy in your apartment



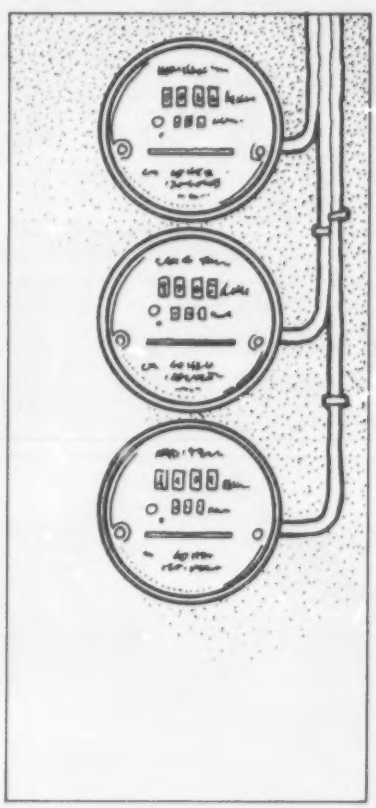


can reduce energy requirements and costs as much as 10–30 percent.

Is your building adequately insulated? If not, recommend that insulation be installed in the ceiling and sidewalls. This, too, has a very positive effect on energy conservation. Low cost loans are available from most banks for installing insulation, as well as for permanent storm windows and storm doors.

Are some areas of your building heated unnecessarily? (Basements and storage areas are common culprits.) Let your building owner know about this, but also point out that heating ducts and water pipes in unheated areas should be insulated so that heat is not lost.

Don't drop your efforts on behalf of energy conservation after one letter or conversation. Be persistent. Energy shortages will persist until enough people care to do something about them.



Energy Conservation: a Two-Way Street

Rising energy costs affect building owner and tenants alike. If heat is included in rental fees, the building owner is realizing lower profits, and tenants can expect a rent increase when lease renewal time comes around. If apartments are separately metered but the building is not weathertight, tenants are probably unhappy with high fuel costs and will look for more economical and energy-efficient apartments in the future. By making building improvements that conserve energy and by installing separate electric and (or) gas meters, a building owner gives tenants an incentive to conserve energy and maintains a competitive stance in the apartment marketplace.

Involve Others

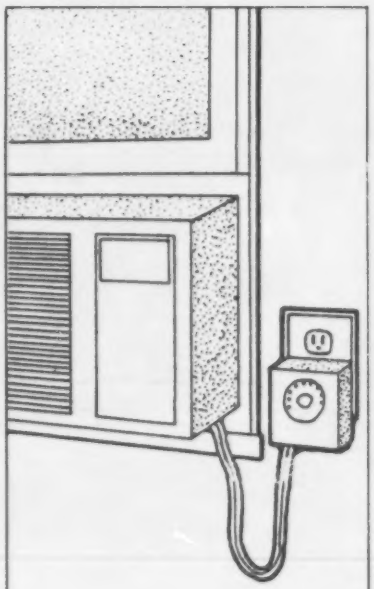
Share your feelings about energy conservation with neighbors and encourage them to become energy savers and advocates. If you live in a large building and have a tenants' association, suggest that a speaker be invited to address members on energy conservation. Your county Cooperative Extension office can help you find speakers.

Energy Conservation Tips

There are many small ways you can conserve energy in your apartment. Small, consistent efforts by individuals add up to big savings for all.

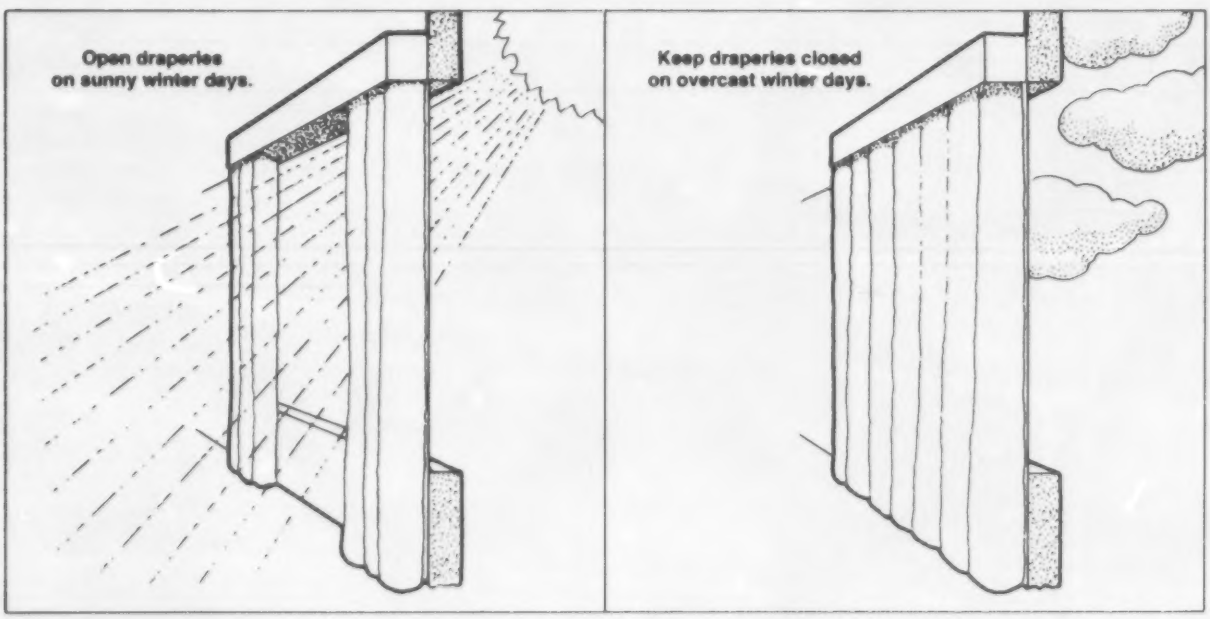
If you have a thermostat, keep it set between 65°and 68°F (18°–20°C) during the day and set it back to 60°F (16°C) at night. Don't "fiddle" with a thermostat setting; that wastes energy. If you feel chilly, put on a sweater. Keep heat registers, radiators, or baseboard heating units free of dust and don't block them with furniture.

Air conditioners, often heavily relied on by apartment occupants, consume huge amounts of energy. An energy advocate uses a cooling unit prudently. If you want a cool apartment when you get home from work, connect the unit to a timer and set it to go on a half-hour before your arrival time. A thermostat setting of 78°F (26°C) or above is strongly recommended for air-conditioned areas. Site a window air-conditioning unit in a window where it will be most protected from direct sunlight. Keep windows and doors closed when an air conditioner is running and close draperies and (or) shades on sunny windows, but don't block the cooling unit. The use of light-colored opaque window shades on southern- and western-exposure windows could save 21 cents of each air-conditioning dollar.



Connect an air conditioner to a timer.

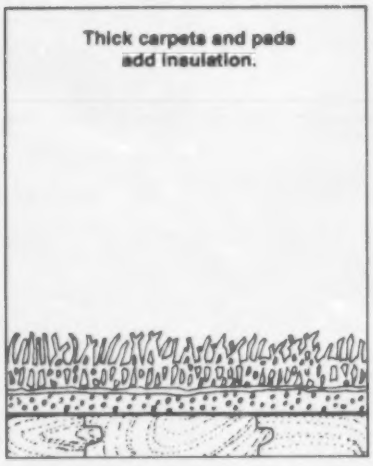
The hot water you take for granted in your apartment requires large amounts of energy for heating. Instead of baths, take quick showers; you'll use less hot water. Try to cut down on the number of times you use your dishwasher. Run only full loads, preferably in the early morning or late evening when energy demands on utility companies are lowest. If you wash dishes by hand, don't let water run continuously; fill a pan with hot water for rinsing. Use as low



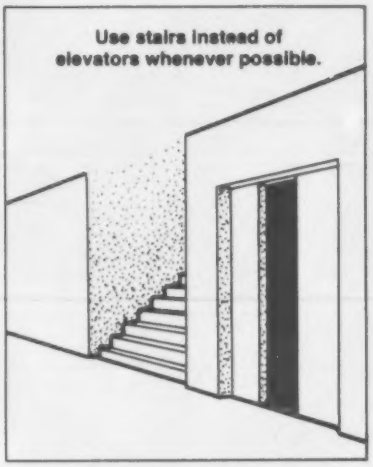
a water temperature for washing clothes as will give satisfactory cleaning; use cold water for rinsing.

Because glass is a poor insulator, a great deal of heat can be lost through windows. Light-colored opaque roller shades can reduce heat loss by 24 to 31 percent. When choosing more elaborate window coverings, select glass-fiber draperies lined with insulated material. A cornice over the top of the draperies will prevent a draft tunnel effect. On overcast winter days and at night, keep shades and draperies closed; open them on sunny days to take advantage of solar heat. In summer, keep windows closed and covered during the hottest hours of the day; open windows, top and bottom, after sunset. If possible, open windows opposite one another to get cross ventilation.

When purchasing furniture and carpeting, keep these facts in mind: Wing chairs, covered in soft fabrics, feel warmer than plastic- or leather-covered chairs and offer protection from drafts. Thick, dense carpeting of wool or acrylic offers good insulation. Carpet padding or cushion improves the insulation qualities of carpeting.


Thick carpets and pads add insulation.

By necessity, many high-rise apartment buildings are equipped with elevators. Use them, but bear in mind that elevators use energy and are costly to maintain. Use stairs whenever possible, especially for short trips between floors.


Use stairs instead of elevators whenever possible.

If your apartment has a fireplace, be sure to keep the damper closed completely when the fireplace is not in use. An open damper allows large amounts of heated air to escape from a room.

Keep dampers closed when fireplace is not in use.

Energy is often unwittingly wasted. As your sense of energy awareness heightens, you will no doubt find many ways to conserve in addition to those outlined here. Manual sections on lighting (pages 53–54), appliances (pages 41–52), decorating (pages 55–56), and hot water (pages 37–40) should be especially helpful as you strive to make your apartment more energy efficient.

12

Your energy-efficient mobile home

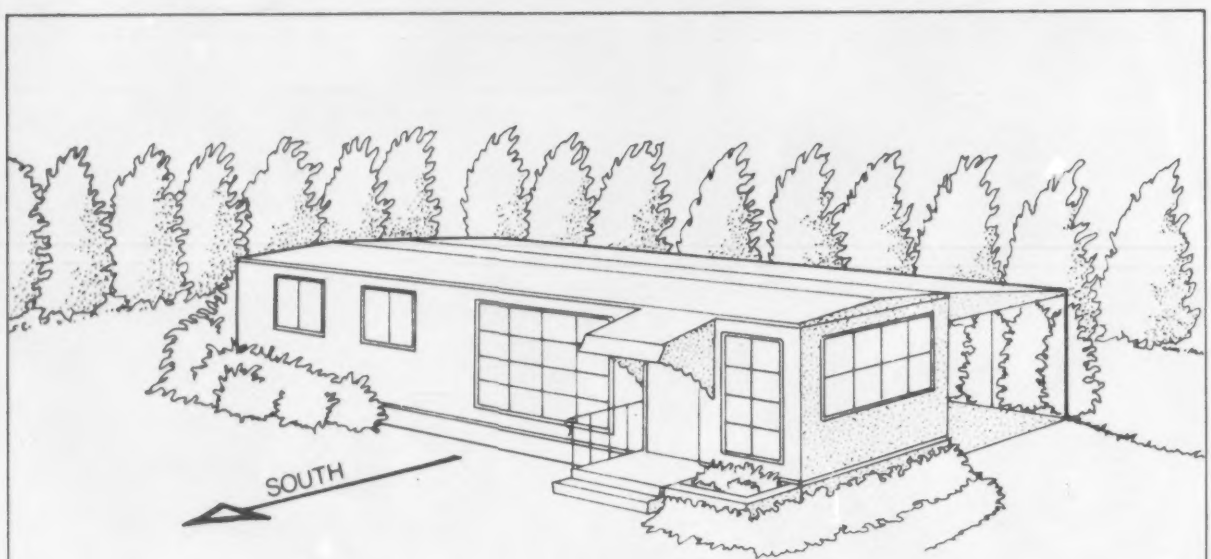
All of us face declining energy resources and increasing costs. The need to conserve energy is pressing, and it applies equally to occupants of houses, apartments, and mobile homes.

Whether you already own a mobile home or are considering the purchase of a new one, there are several steps you can take to save energy and dollars and, at the same time, make your home more comfortable.

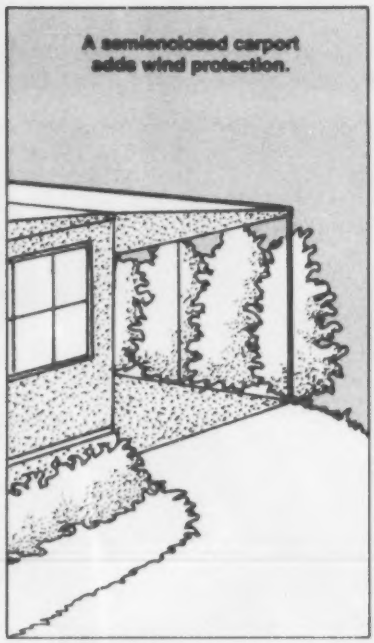
Purchasing a Mobile Home

When you purchase a new mobile home, buy according to the Mobile Home Construction and Safety Standards issued by the U.S. Department of Housing and Urban Development (HUD), effective June 15, 1976.

A mobile home built according to Subpart F of the HUD standards meets basic requirements for condensation control, air infiltration, thermal insulation (in the ceiling, walls, and floors), and has a label permanently affixed on an interior wall certifying, according to climatic conditions, the capability of heating and cooling equipment. The climate of the northern part of the United States requires Zone II certification. The standards are the result of research by mobile home manufacturers and insulation engineers. A home insulated to HUD's performance standards is more comfortable in winter and summer and is more economical to



A properly sited mobile home on a well-landscaped lot increases energy efficiency.



A semienclosed carport adds wind protection.

operate than a home with less thermal protection.

Some mobile homes manufactured today exceed minimum HUD performance standards for thermal protection and are labeled with "Energy Conserving Home" tags, as well as HUD heating and cooling certificates. You can expect even greater comfort and economy of operation from them.

Siting and Shading on Your Own Lot

Much of the comfort you seek in your mobile home and the home's efficient use of energy are determined by its placement or siting. In the northern part of the United States, site a mobile home so that the long sides face north and south. This will give maximum heating value from the sun. Protect your home against prevailing winter winds by building a semienclosed carport or by planting a windbreak of evergreens along the north and west sides of the home. A tall fence can also be used as a windbreak.

Well-planned awnings or porches on the southern side, deciduous trees on the east and west sides, wind protection on the north, and shrubs planted along the mobile home skirt will all help to protect the structure from summer sun and winter winds. Another important consideration would be to site your home so that the kitchen area **does not** have a western exposure.

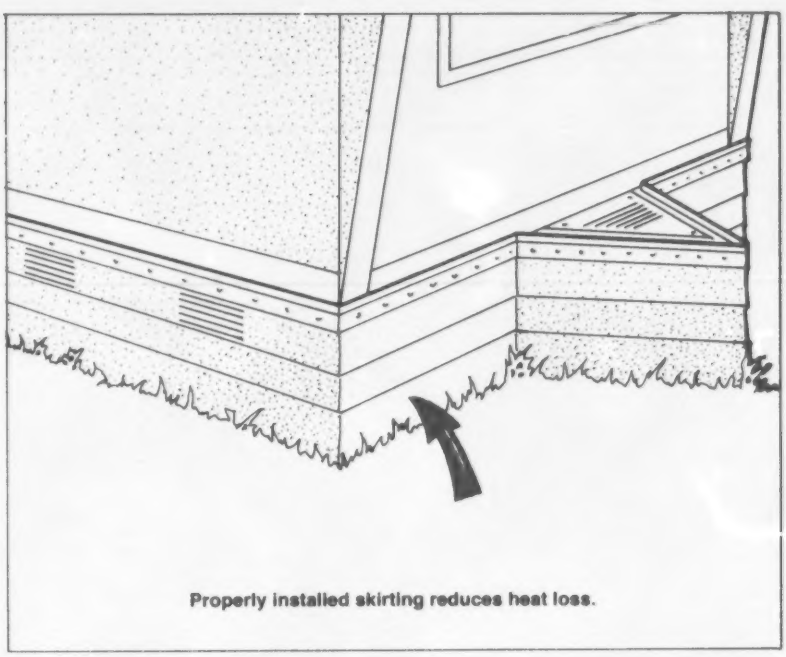
Skirting

Full and properly installed noncombustible skirting on a mobile home acts as added insulation and helps to reduce energy use. Never use bales of straw as a substitute for skirting. Vents should be provided in the skirting to allow for air circulation to prevent moisture accumulation and for the heating system's air-combustion intake.

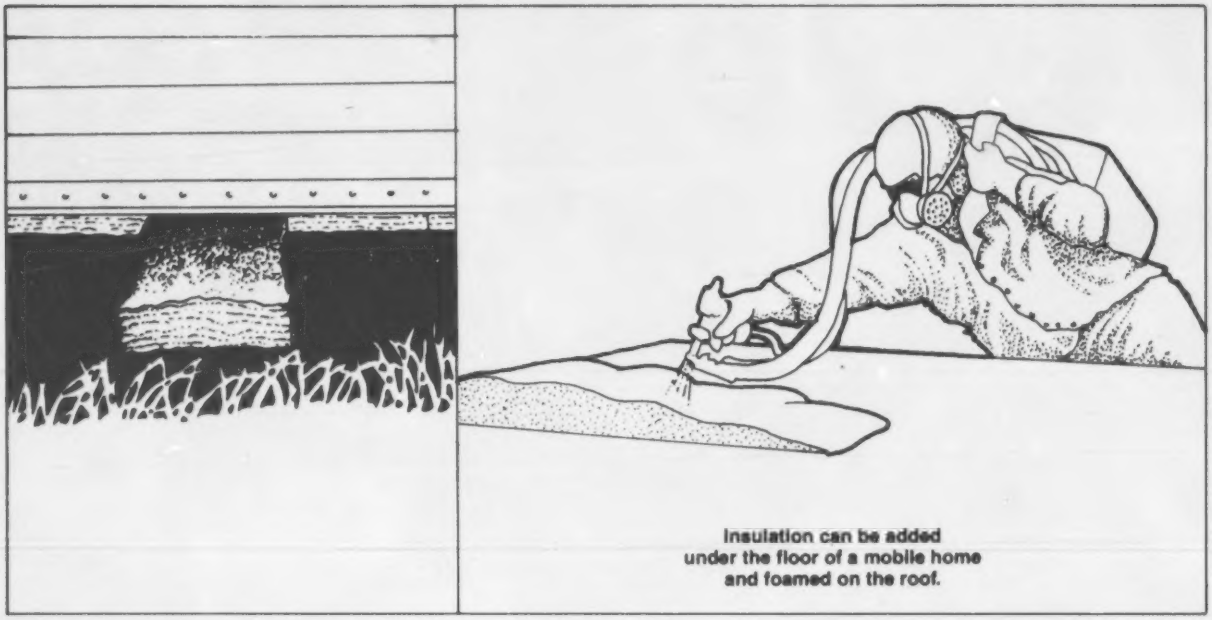
Insulation

In most mobile homes, it is possible to add insulation to the roof and floor. A urethane material can be sprayed on the roof to a thickness of 2"–3" (5–7.5 cm). Urethane is quite effective in reducing heat loss in winter and heat build-up in summer. It should be coated with a protective sealer to keep it from discoloring and deteriorating. R-19 glass-fiber batt insulation can be installed under the floor and held in place with chicken wire.

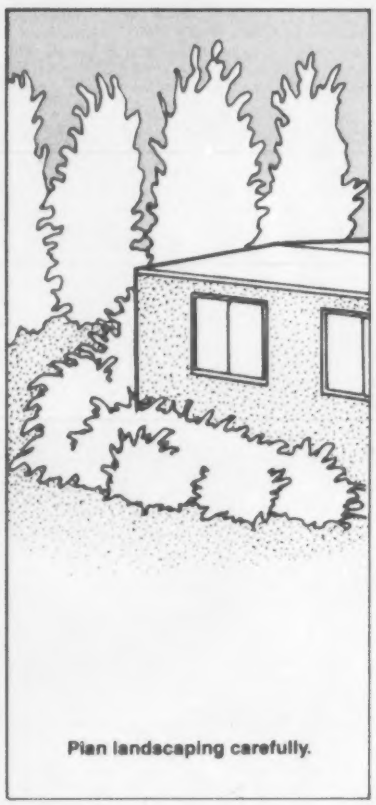
To avoid freezing and possible rupture and to reduce standby losses, all exposed water pipes should be covered with pipe insulation. This can be purchased at hardware and building supply stores. In extreme cases, it may be necessary to use an electric heat tape to keep pipes from freezing. Heat tapes must be installed very carefully. Instructions for proper installation can be found on page 39.



Properly installed skirting reduces heat loss.



Insulation can be added under the floor of a mobile home and foamed on the roof.



Plan landscaping carefully.

Caulking and Weather Stripping

Air leaks and cracks, however small, increase the cost of heating and cooling a home and can result in moisture entering and damaging the structure. Check your home carefully for cracks and openings around the moldings, joints, nails, splash panels, windows, top seams, doors, roof vents, and wheel housings. Using a caulking gun or putty knife, plug and seal all openings with a quality caulking compound. The best compounds remain elastic when dry and are available in colors to match exterior finishes. Complete and proper weather stripping around windows and doors will also cut heat losses. Manual sections on weather stripping and caulking (pages 10–13) tell you how to do the jobs correctly.

Plastic Storm Windows

The 1976 HUD standards require storm windows or insulating glass in mobile homes. If storm windows are not available for your present mobile home, or even if you have them, the installation of 4- to 6-mil plastic sheeting over windows will reduce heat loss. You may want to leave one or two windows on the south side of the home uncovered in case there is a warm day when an open window would be desirable. Plastic sheeting can be held in place on the outside of a home with masking or pressure-sensitive tape and removed at the end of the heating season.

Temperature Control

A daytime thermostat setting of 65°–68°F (18°–20°C) is recommended for the heating season; a 5°–8°F (3°–5°C) setback is recommended for nighttime hours. Exhaust fans in the kitchen and bathroom are useful to vent excess moisture, but use them sparingly during the winter. Exhaust fans are not effective for use as a total air-circulation system.

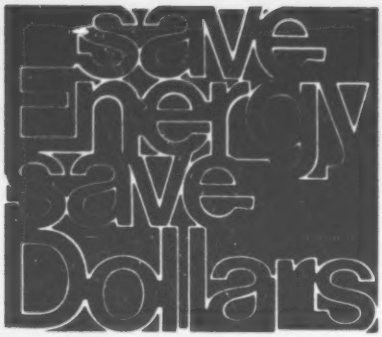
Heating Systems

A well-maintained gas- or oil-fired heating unit will make the most efficient use of energy. An annual check by a heating contractor before the start of the heating season will help to keep your system operating at maximum efficiency.

Heating ducts are often located underneath a mobile home. This results in excessive heat loss. Cover all exposed ducts with a minimum of R-4 insulation. The heating system should always have an outside vent for combustion air to enter the heating unit; this vent should **never** be covered.

For additional information on heating system maintenance, see pages 27–36.

As you work on the energy efficiency of your mobile home, you will want to check other sections of this manual. The sections on summer cooling (pages 34–36), appliance selection and use (pages 41–52), hot water (pages 37–40), and landscaping (pages 59–60) should be especially useful.



13

Energy efficiency in transportation

- **Automobiles use 14 percent of *all* energy consumed in the United States.**
- **Probably, the most expensive item in your personal energy budget is the operation and maintenance of your car(s).**

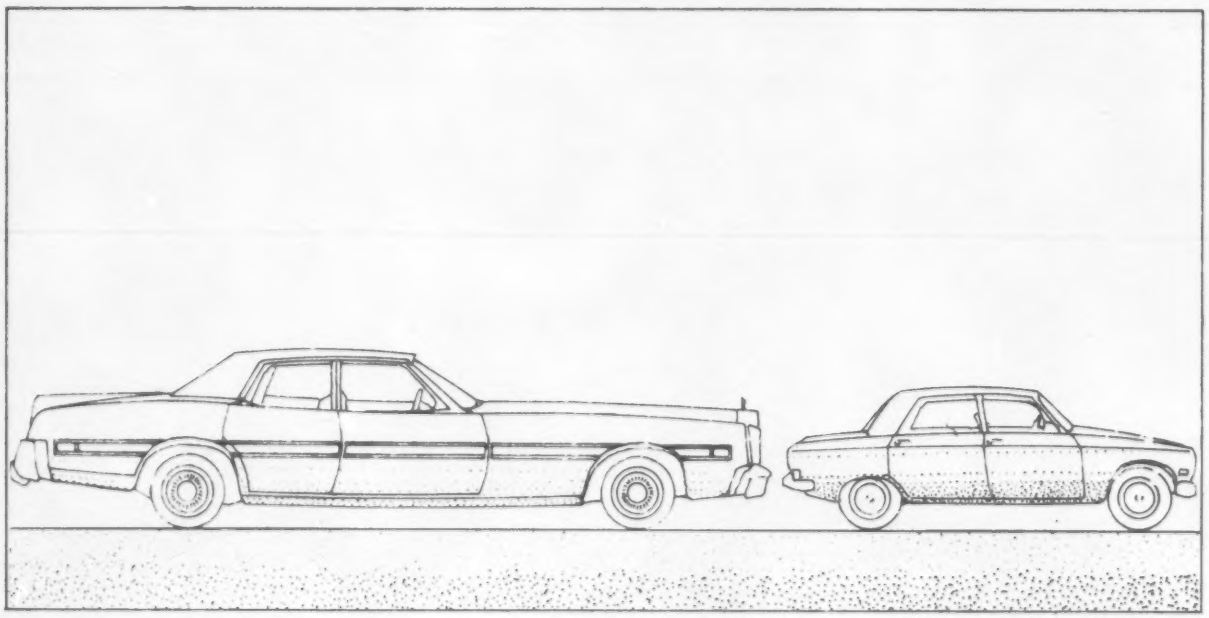
Shocking facts aren't they?

It would be difficult for Americans to imagine life without a car. The problem is not that we have automobiles, but rather that we must learn how to use automobiles efficiently and save energy in the process.

- **The United States accounts for approximately 6 percent of the world's population and over 46 percent of the world's automobiles.**
- **It is estimated that more than 21,000 square miles (54 600 square kilometers) of land have been paved over to accommodate this country's 100 million cars.**

Purchase an Energy-Efficient Car

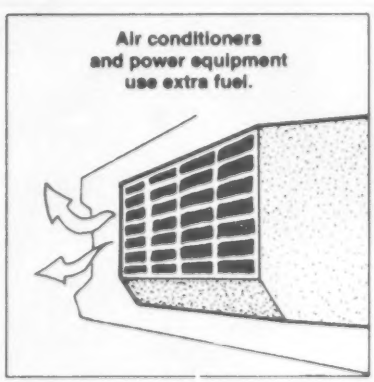
An automobile's fuel economy is determined by weight, engine type and size, and maintenance. Before you buy an automobile, familiarize yourself with the fuel economy of various models. The information can be found in the **Gas Mileage Guide**, published annually by the



Environmental Protection Agency (EPA) and the Federal Energy Administration (FEA). All new car dealers are required by law to have the Guide available in their showrooms. Or, you can request a free single copy of the Guide from: Fuel Economy, Pueblo, Colorado 81009. EPA tests are conducted under controlled conditions; therefore a driver can expect some variation from the test results.

As you read the Guide, you will see that small, lightweight cars are more economical to operate than full-size, heavy cars. In general, in city driving, a 5,000-pound (2250-kilogram) car uses twice as much fuel as a 2,500-pound (1125-kilogram) car.

Buy a car on the basis of minimum-size requirements, purchase price, and estimated fuel costs. Be reasonable about optional features. An air conditioner reduces fuel economy 10–20 percent when used in stop-and-go traffic. If you must have air conditioning, use it only when absolutely necessary. Automatic transmission and power steering also use more fuel than standard transmission and steering. Power brakes, motor driven windows, and power seats and radio antennas don't require much energy to operate, but the weight added to a vehicle reduces fuel economy.

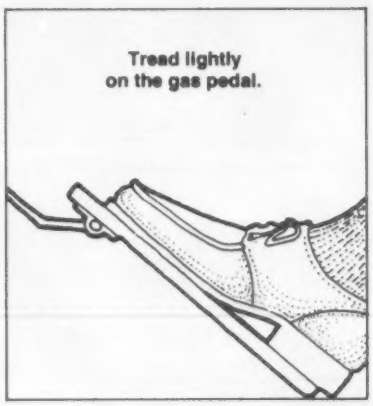


Save Fuel as You Drive

Fuel economy decreases in direct proportion to air drag on a vehicle. For example, if you increase your automobile speed from 55 miles per hour (mph) (90 km/h), the legal limit, to 65 mph (105 km/h), the increase in the car's draft resistance goes up by 40 percent and fuel economy decreases. Best fuel economy occurs at speeds of 30–40 mph (50–65 km/h) with no stops or rapid speed changes.

Develop driving habits to help you save fuel. Accelerate smoothly to save gasoline and wear and tear on the engine and tires. Drive at a steady pace and anticipate speed changes; sudden changes in speed waste gasoline. For example, take your foot off the accelerator as soon as a red traffic signal is spotted ahead. Drive slowly for the first mile (couple of kilometers) instead of letting your car warm up by idling; an idling average-size engine burns about a pint (500 milliliters) of gasoline every 12 minutes. Avoid overfilling a car's gas tank; fuel spillages are wasteful, too. Don't carry unnecessary weight in or on a car; the heavier the car, the more gas it uses.

You probably have an idea of the current gas mileage of your car. As you develop energy-efficient driving techniques, check the car again to see if you are getting better mileage. There are five steps to follow for an accurate mileage test: (1) Fill the gas tank full and make a note of the mileage on the odometer. (2) Keep a record of all gasoline added during the test period. (3) At the conclusion of the test, again fill the tank full. (4) The gas added during the test, plus the gas required to refill the tank at the end of the test, is the total gas used for the test. (5) The gas mileage is equal to the number of miles (kilometers) driven during the test divided by the total gas used. For accuracy, the test should be conducted over 600 to 1,000 miles, or 3–4 tanks of gasoline. (In the metric system, gasoline consumption may be given in liters per 100 kilometers.)



Automobile Maintenance

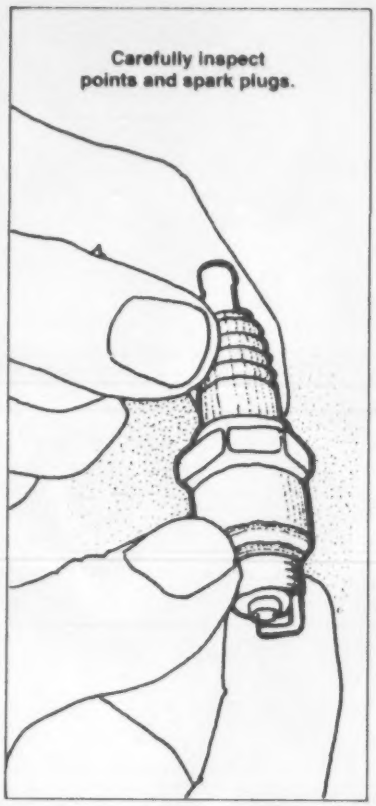
An automobile cannot maintain energy-efficient performance without proper maintenance. Automobile tune-ups not only save fuel, they also provide easier starting and smoother operation. A car that is properly maintained averages 6 percent better mileage per gallon of gasoline than a car that needs new ignition points and spark plugs.

Gasoline engine components that are the most common cause of poor power and increased fuel consumption are the spark plugs, ignition timing, the air cleaner, and carburetor adjustments. A spark plug that is not functioning properly can waste as much as 1 gallon (3.8 liters) of gasoline in every 10 (38). Ignition points in the distributor that are out of adjustment or deteriorated from use can result in starting difficulties and poor performance. The air

cleaner is a passive device, but for each gallon (3.8 liters) of gasoline burned, approximately 10,000 gallons (38 000 liters) of air must pass through it. A dirty and partially clogged air cleaner starves the carburetor of air; therefore, the optimum fuel–air mixture is not obtained, and the fuel is not used at its optimum efficiency. Carburetors require regular adjustments in order to maintain automobile performance.

New-car owners' manuals recommend tune-up frequency; faithfully follow the suggested plan. You can do this by finding a reliable automobile mechanic, familiar with your particular car, to do the work or by doing tune-ups yourself. Most community colleges and adult education programs offer courses in automobile maintenance.

In order for your car to operate at highest efficiency, it is also important to use the recommended gasoline octane rating and oil grade. Check your owner's manual.



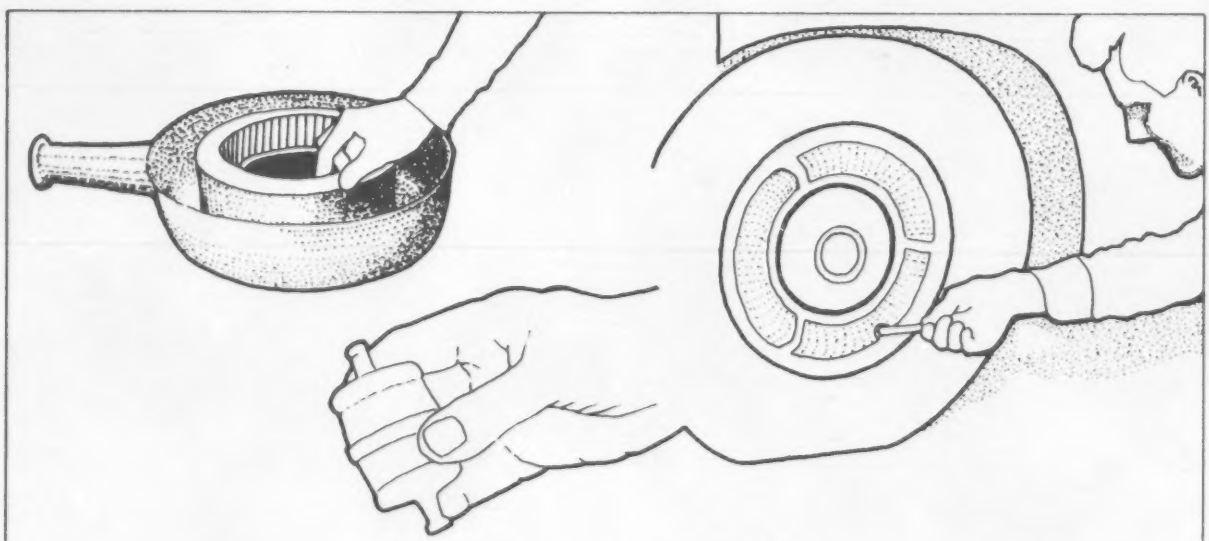
Carefully inspect points and spark plugs.

Tires Affect Fuel Efficiency

Proper inflation and type of automobile tires can provide better gas mileage and can save you money. Underinflation is probably the greatest cause of tires wearing out too fast. Underinflation also increases the rolling resistance of a tire; thus it requires more energy per mile (kilometer) to roll the car along the highway. Some tests show that 30 percent underinflation — and that is far from being a flat tire — reduces tire life by about 50 percent.

Radial tires, because of their design, develop less rolling resistance than standard tires. One can expect a 5 percent improvement in fuel economy by switching to radial tires.

A very useful accessory for good tire life is an accurate air gauge. In particular, radial tires, when properly inflated, often appear to have a "flat" appearance. It is difficult to distinguish by eye when



Regularly check air cleaner, fuel filters, and tires.

a radial tire is underinflated. Get in the habit of checking regularly the inflation of your car's tires.

Synthetic Oils

Synthetic engine oils, used in some automobiles today, belong to two basic classes: one, called esters, is made by reacting alcohol with certain types of acids; the second, synthesized hydrocarbons, is fabricated from various hydrogen- and carbon-containing molecules found in natural petroleum. Mineral oils, the oil used in most automobiles today, are usually changed after 6,000 miles (10 000 kilometers) of use. It is believed synthetic oils can safely be used with oil changes at 12,000-mile (20 000-kilometers) intervals. Although synthetic oils cost 4–5 times as much as mineral oils, cars lubricated with synthetics show an average 5 percent improvement in gas mileage over those using conventional motor oils.

Car Pools Can Save Money

Over 80 percent of working Americans commute to work by automobile; more than 50 percent of them drive alone. A car pool to and from work not only saves gasoline and money, but also saves wear and tear on cars. Ask your employer to help establish car pools at your place of business.

Another type of car pool frequently overlooked is better scheduling of family trips by automobile. Family automobile travel — shopping, visiting, trips to the doctor, to music lessons, or to athletic events, for example — accounts for nearly one-third of all passenger trips in this country and averages 5½ miles (9 kilometers) one way. If, by planning ahead to combine errands and appointments, a family took one less trip per week (7 trips instead of 8), that family could save $75 per year. To take it a step further: if every automobile in the United States consumed 1 less gallon (3.8 liters) of gasoline per week, national demand for gasoline would be reduced by about 7 percent!

Transportation Alternatives

Engineers often measure energy in British thermal units (Btu), the amount of energy required to raise 1 pound of water 1 degree Fahrenheit; or joule, the amount of energy required to produce 1 watt for 1 second. A comparison of these energy units for various modes of transportation is revealing. Walking requires about 300 Btu's (316 200 joules) per person per mile (1.6 km); a bicycle requires 200 Btu's (210 800 joules) per mile (1.6 km). In contrast, driving an average-size automobile with no passengers requires 8,100 Btu's (8.5 million joules) per mile (1.6 km) in the city and about 3,400 Btu's (3.5 million joules) per mile (1.6 km) on the highway. In terms of energy usage, bicycling and walking are obviously very energy efficient means of individual transportation. Fully loaded buses and trains are much more efficient modes of transporting people than the automobile. In order to save energy and dollars, use alternative means of transportation whenever possible and, if it is feasible, advocate the establishment or improvement of mass transportation systems in your locality.

Energy consumption **must** be reduced in this country. A good place to start is with the family automobile.

14

Recreation and energy conservation

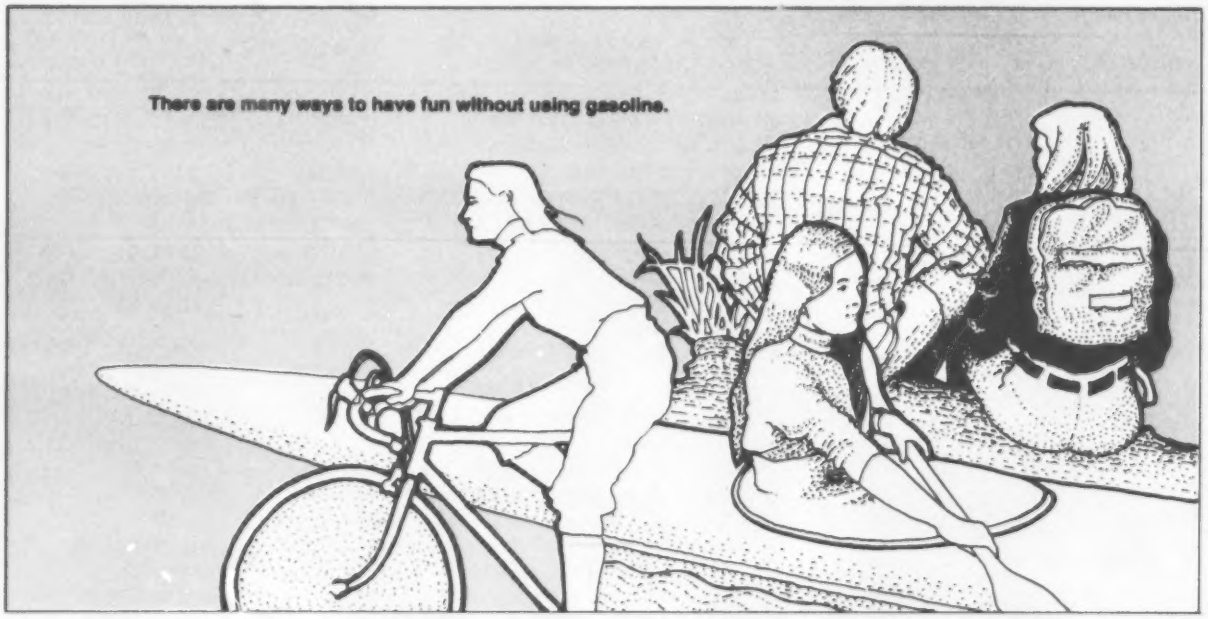
The need to save energy touches every facet of our lives: at home, work, and school; in transportation; and in the manner in which recreation needs are met. A quick dip in the pool, the long-planned vacation, an evening out at a local high-school sporting event — all may have negative effects on energy conservation, but at the same time, all could be planned in such a way that their energy impact would be lessened.

Save Energy, Save Dollars does not question individual preferences in recreation or recreational equipment; it does advocate the efficient use of energy for recreation.

Swimming Pools

Contrary to popular belief, a swimming pool filter does not need to run continuously. The amount of dust and leaves blowing into a pool and the level of use determine how frequently pool water must be filtered. The amount of time a filter needs to be operated can be determined by trial. For example, if pool water appears visually clean when the filter is operated only half the time, try a 12-hour-on–12-hour-off schedule. This can be done automatically by connecting the filter to a time switch. A savings of $10–$15 per month on your electricity bill is possible if a pool filter is operated only as needed.

When automatic chemical dispensers are used with a pool



filter, the concentration of chemicals can be adjusted to the operation schedule of the filter. Indirectly, you can save energy by using the minimum amount of chemicals necessary to maintain pool sanitation.

In many utility company service areas, the heating of private pools is banned. Whether or not this is the case in your area, be energy efficient: rely **only** on solar energy for heating a pool.

Vacations and Camping

When you travel away from home, consider using mass transportation, trains and buses, instead of the family car, and try to stay in one place instead of "hopping" around. You can see more of an area that is new to you if you get to know it by hiking, walking, and bicycling.

Camping vacations, ever-growing in popularity, utilize a wide range of equipment. Those who use tents or small camping trailers use less fuel; however, it is important to be energy-conscious with all types of camping equipment, from camping stove to mode of transportation. Consider camping close to home instead of traveling long distances. Very attractive state and private campsites have developed throughout the northeastern part of the United States.

Recreation Vehicles

Motor homes. It is important to use a motor home only for necessary travel; most are **not** good for second cars or for running short errands. More and more, motor-home owners carry with them bicycles or a small motorcycle to use for local transportation when they travel away from a campground. The smaller the motor home and the lighter in weight, the better the gasoline mileage. To save energy with a motor home, refer to the section of this manual on automobile operation and maintenance (pages 77–80).

Boating. It can be argued that sailboats, canoes, and rowboats are the most energy-efficient means of boating; however, you may prefer power boating. Maintenance of a power boat is as important as it is with an automobile. Avoid unnecessary operation and use a power boat, or any boat, as close to home as possible. Carrying or towing a boat by car reduces an automobile's fuel economy.

Trail bikes and snowmobiles. A major use of fuel for these recreational vehicles is the travel involved in getting to locations where such vehicles can be used. If you are a trail bike or snowmobile enthusiast, advocate the development of trails near your community to avoid traveling long distances to developed sites. Keep trail bikes and snowmobiles in top operating condition: tune them regularly and follow the manufacturer's maintenance recommendations.

Motorcycles. Because motorcycles use very little fuel per mile (kilometer), people who use them instead of automobiles for local transportation or for sightseeing get about very energy efficiently. As with all types of powered vehicles, motorcycles should be tuned and maintained as directed in owners' manuals.

Bicycles. A bicycle is an excellent way to save energy and dollars. Ride a bike for exercise, to sightsee, and, whenever possible, to work. Encourage the development of safe bikeways in your community.

Other Recreation

Other forms of individual or family recreation play a role in saving energy. Again, it is recommended that you be energy conscious when you make recreation choices.

Skiing. To save energy getting to ski areas, downhill skiers are encouraged to use the ski slope nearest home. If you're considering taking up skiing, look into Nordic or cross-country equipment. It's less expensive than downhill; and all you need, once you have the equipment, is a trail, a nearby park, or an open field.

Sporting events. Whenever possible, advocate the scheduling of daytime games to avoid lighting requirements for athletic events. Organize car pools among friends and neighbors to and from athletic events; you'll be saving energy. The rush for the gates at the end of big athletic events results in many gallons (liters) of gasoline being wasted in traffic jams. Save your temper and energy: leave early or wait until traffic lets up.

Family recreation. If you own a vacation home, equip it for energy efficiency just as you do your year-round home. In any living situation and at any time of year, look into table and yard games for family recreation. There's much to be said for fun, for getting to know one another, and for energy conservation right in your own back yard.

15

Energy conservation: awareness, attitudes, education

Single homes made energy efficient by conscientious people are to be encouraged. But the need for and impact of energy conservation must spread beyond individuals to neighborhoods, to business and industry, and to education.

The suggestions and instructions in this manual should provide most of the information you need to become an effective energy-conservation advocate. Take it upon yourself to be a source of information and encouragement to those around you. Spread the word.

As an Employee

Rising costs of fuel and curtailed supplies are affecting the profit and loss columns of business and industry, with many large companies under mandate to reduce energy consumption by 15 percent or more. Therefore, all companies, large and small, are seeking ways to reduce energy consumption and thereby increase profits. If you see energy being wasted in your place of employment, let your employer know about it and, if possible, offer some suggestions of ways to eliminate waste. Don't hesitate if your suggestion would save only a small amount of energy; small differences add up to big reductions in the long run.

As an Employer

An energy-efficient office, factory, or commercial business serves as an example to employees and to allied businesses. Encourage your employees to be energy efficient on the job by establishing energy incentive programs: reward employees' suggestions of ways to eliminate energy waste in your place of business; offer premium parking spaces to employees who car pool or drive small, energy-efficient automobiles; arrange working hours that allow employees to travel together to and from work and help them arrange car pools. If you operate a bus to and from parking areas, consider scheduling runs during lunch hours to shopping centers or business districts. That would save many individual car trips.

Extend your concern for energy conservation beyond your place of business. You can supply employees with copies of this manual and encourage them to follow through with energy-saving

measures at home. Public libraries often have films available on energy conservation; borrow them and show them to your employees. Invite speakers to discuss energy conservation measures; your county Cooperative Extension office can help you here. The possibilities go on and on. Your role as employer–energy advocate is only limited by imagination.

As a Customer

A customer can be a very effective energy-conservation advocate. If you see energy being wasted when you shop — a door left open, excessive lighting, the temperature too high in winter, too low in summer — take a moment to tell the manager. Consumers are usually responsible for encouraging stores to maintain extended hours and to stay open 7 days a week. If customers planned schedules better, perhaps extra shopping hours would not be needed, especially in large shopping malls. Whenever you as a customer have an opportunity, voice your opinions about energy conservation. When enough people care, we can be effective.

As a Club Member

Encourage social, community, and even church groups to schedule energy conservation programs. Speakers are available through your county Cooperative Extension office and through most utility companies. A local hardware or building supply dealer might also be available as a speaker. Remember the objective: spread the word.

Youth Education

A whole new generation of energy users is at a very impressionable age. Many readers of this manual are involved with elementary and secondary education and with youth groups such as 4-H or scouting. If you are one of them, incorporate energy-conservation instruction into your teaching program. You will be doing a great service to young people by teaching them how to save energy — and money. After all, they are the ones who, a few years hence, will be facing even more serious problems if they do not learn how to stem the present tide of energy waste. County Cooperative Extension offices can provide teachers and leaders of youth groups with Save Energy Save Dollars fact sheets, material based on this manual and easily adapted for classroom and youth group instruction.

If your school district does not offer instruction in energy conservation, approach members of your board of education, whether or not you are a member of the teaching profession. Explain the need for courses in energy conservation and encourage their establishment.

Adult Education

Adult education and vocational training opportunities are excellent in most states. When you have an opportunity to peruse brochures from your community college or local adult education program, look for courses that will teach you and your neighbors how to save energy and dollars. If you do not find such programs listed, put on your energy-advocate hat and ask that such courses be instituted. For example, a short course in automobile repair and tuning can teach a person how to save gasoline as well as expensive repair and maintenance bills. A few basic skills learned in a woodworking course will give the training and, possibly, the incentive to tackle minor repair and remodeling jobs around the house. Such a course would be especially useful when arranging to add more insulation or when carrying out minor construction projects in order to save energy. Courses in small appliance repair and basic household maintenance can also be a means of learning how to save energy and money.

Hardware and building supply dealers are other sources of education and assistance. Don't hesitate to ask dealers for brief instructions on how to repair a leaky water faucet or how to apply caulking compound or install weather stripping. Most dealers will be happy to help: it's good customer relations. Some hardware and building supply firms also offer do-it-yourself seminars for homeowners; watch and listen for announcements and get your reservation in early.

When seeking energy conservation information for yourself or others, don't overlook your local public library. Books, films, magazines, and brochures on energy-conservation theory and techniques are available or can be obtained from a larger library at no charge to you. Ask the librarian for assistance.

A last, but certainly not least, source of help may be the person next door. Swap information and skills with neighbors. Cooperating with others in your community can be fun and a real source of encouragement. For example, if three or four homeowners get together and help one another install attic insulation, it will be an easier job for all. Saving energy can be contagious; if enough people get really excited about it, much can and will be accomplished.

16

Energy conservation for young people

A successful energy conservation program is not the sole responsibility of the head of a house, nor even the adults in a family; it must involve all household members. A child develops an awareness of the need to conserve energy if taught at an early age the "whys" and "hows" of energy conservation. An adult's shared concern, positive example, and willingness to instruct are a child's most valuable learning tools.

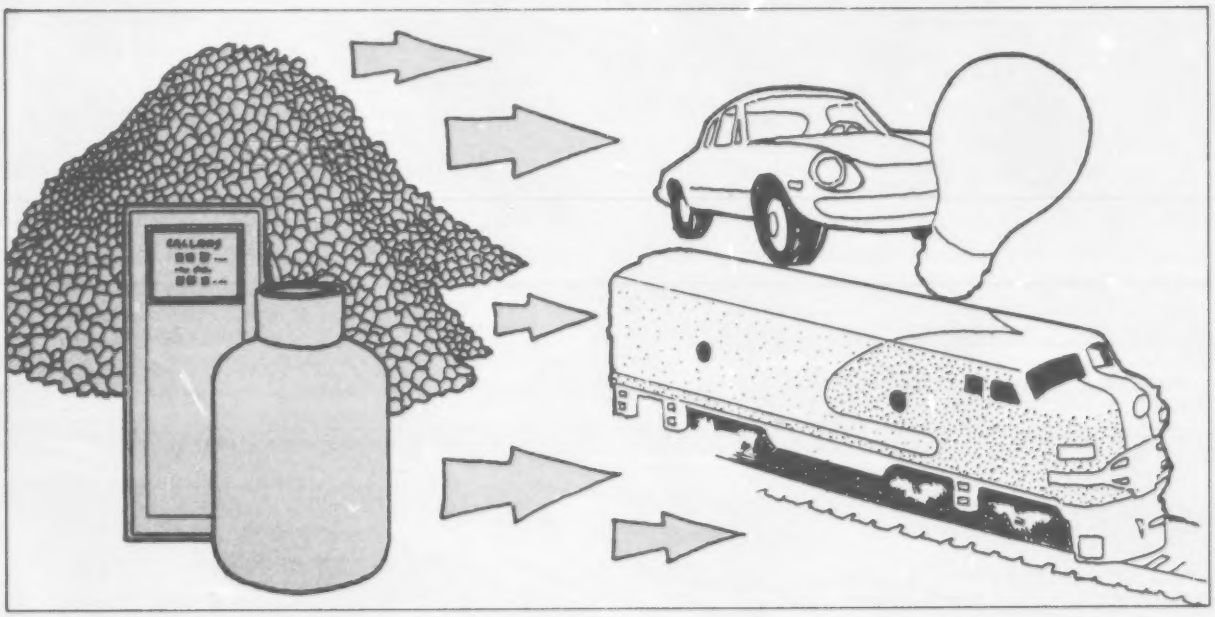
The following section of the manual is directed toward those members of the household about 12–16 years of age. It is hoped that older family members will read through the material with younger children and then help and encourage them to be "energy misers."

What Is Energy?

Energy is the ability to do work; it produces power, heat, and light. In order to function — from vigorous exercise to sleeping — the human body needs energy. Humans get energy by eating nourishing foods. Machines also need energy to move and to do useful work. Most machines get power by using energy from fossil fuels: coal, natural gas, and oil.

Why Conserve Energy?

Fossil fuels are found in very large, but limited, amounts under the surface of the earth where, millions of years ago, they were formed from decaying plants and animals.



Once used, fossil fuels cannot be replaced. Fossil fuels are used to make electricity, to heat and cool homes and businesses, to operate factories, and for transportation. In the United States, the average person uses 25 times more energy from fossil fuels than is used by a person in a less industrialized country of the world.

Scientists are learning how to harness energy that can be replaced. They have found ways to use energy from the wind, tides, the atom, heat from the earth, and the sun. But until scientists learn how to make these sources of energy safe, dependable, and economical, we must conserve our present energy supplies.

It takes only a few ounces of oil or coal to make enough electricity for a 100-watt light bulb to burn for about an hour or to heat a gallon (3.8 liters) of water to 160°F (72°C). That's not very much oil or coal. But consider all the hot water and electric lights used in your home; think of **all** the energy used in your home. Then consider how much oil and electricity must be used on your block, in your town or city, in all of the United States: Ounces quickly become barrels and tons, millions of them! If you, your family and neighbors, indeed, all of the people in this country used less energy from fossil fuels, we could stretch fossil fuel supplies until other sources of energy are ready to use.

How Can You Help?

Walking, hiking, jogging, and bicycling depend on no energy except yours. Learn how to entertain yourself and how to get from place to place without depending on fossil fuels. If you become independent of fossil fuels now, you will be more apt to continue that way as you grow older. Remember, we must save energy!

Become the "energy miser" in your family. (That means, don't use energy unless you have to.) You can become an energy miser by adopting the preceding suggestions as well as the following tips:

- **Turn off the television, radio, and record player when no one is watching or listening. When looking for entertainment, read a book instead of turning on the television. (Electric lights use less energy than televisions.)**
- **Don't turn on more lights than you need in a room, and turn them off when you leave.**
- **Don't hold open an outside door. Go in and out of a building quickly and close the door behind you. It takes a lot of energy to heat or cool a building.**
- **Don't let water run when you do the dishes or wash your hair, and turn off all water faucets completely; an open or dripping faucet wastes energy.**
- **Instead of baths, take quick showers; they use up to 50 percent less hot water.**
- **Decide what you want from the refrigerator *before* you open the door. Try to open the door only once to get what you need, and do that quickly. Warm air enters the refrigerator and raises the temperature when the door is held open. The refrigerator then uses energy to return the temperature to a cool level.**
- **On sunny winter days, open window blinds, shades, and curtains so that the sun's heat will help warm your home. Close window coverings in the evening to keep heat in a room.**

- **Walk or bike to school if it's nearby instead of asking someone to drive you. When you and your friends plan an outing that involves rides, organize a car pool among families so that fewer cars are needed. Cars use energy—gasoline and oil.**
- **Look for ways to save energy in your home. If you find energy being wasted, offer to help your parents correct the situation.**

- **Let your friends know how and why you're saving energy. Encourage them to become energy misers.**
- **Teach younger children the "whys" and "hows" of energy conservation.**
- **Sun and wind affect the amount of energy used to heat and cool your home. Properly selected and planted trees and shrubs can reduce heating and cooling needs. When it's a gift-giving time, ask for or give a tree as a present.**
- **Ask in school if your class can study energy conservation. If your class comes up with some good ideas or projects, perhaps you could put on an "energy" assembly for the whole school.**
- **Encourage your 4-H club or scout troop to conduct home and community energy-conservation projects.**

Energy-Conservation Activities

Here are tests you can run to help your family learn more about ways to save energy in your home.

Shower vs. bath: Which is more efficient?

For this experiment you'll need a yardstick or meter stick. Run the water as usual for your bath, but **before** you get in the tub, measure the depth of the water. Remember or write down the number of inches or centimeters of water in the tub. The next time you bathe, take a shower. Before you start running water for the shower, close the drain so that the water remains in the tub. When you have finished your shower — make it a quick, efficient one — step out of the tub and measure the depth of the water with the yardstick or meter stick. Compare this figure with the amount of water used for a bath. Which is less? Will you conserve energy by taking showers or baths? If your experiment followed the usual pattern, you'll be taking more showers in the future.

Measure your home's energy efficiency

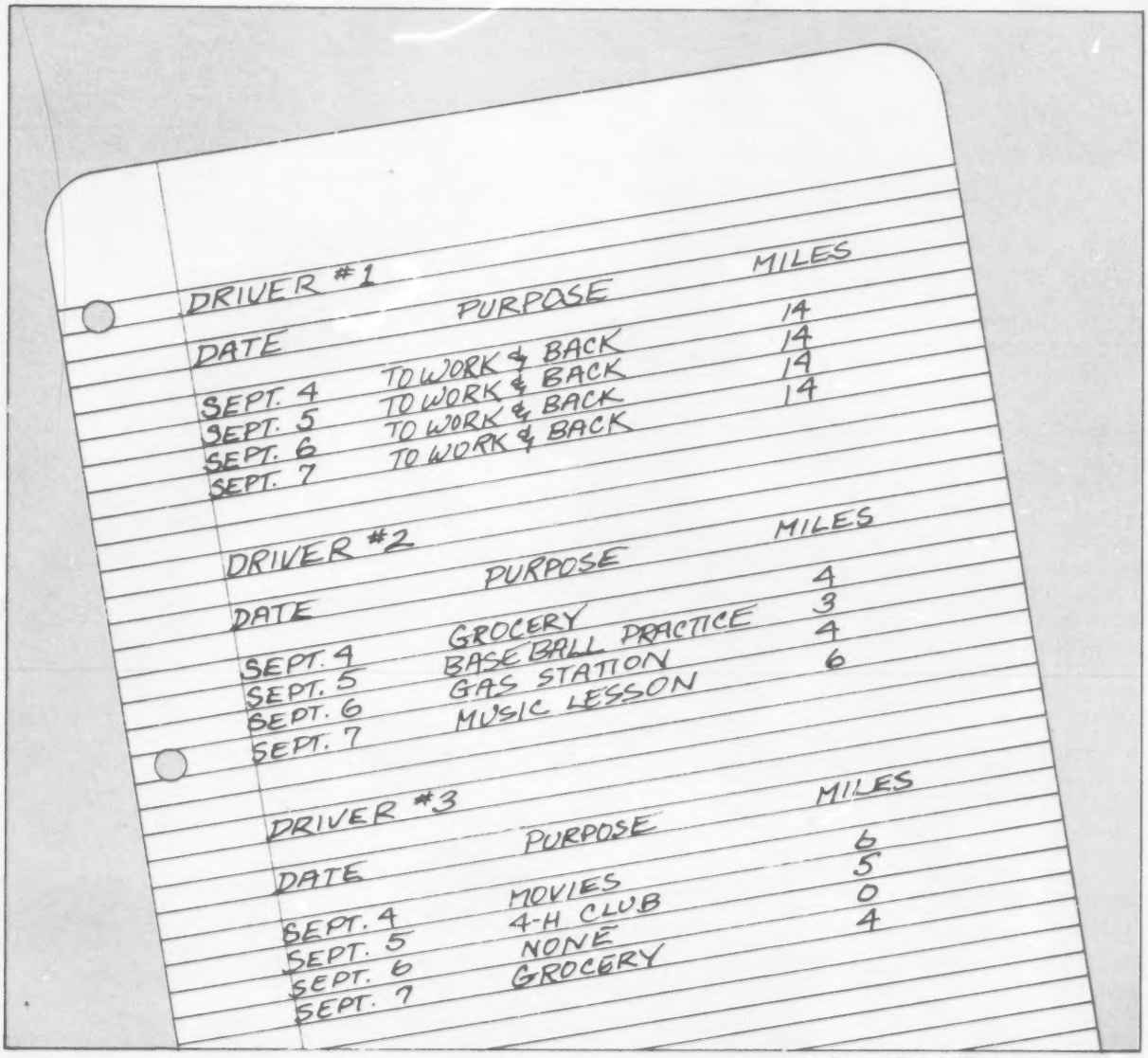
By keeping track of heating degree days (HDD), you can learn the average heating needs for a week, month, season, or year. As your family takes steps to conserve energy in your home, it would be helpful to know how well the measures are working. This isn't always easy to do because one month may be much colder than the preceding one, and in order to keep your home warm, you will use much more fuel. A record of heating degree days will help your family measure the coldness against the amount of fuel used to heat your home. Over time, as your home is made more airtight and as you build up HDD records, the percentage of fuel saved should decline when measured against the HDD information. A description of how to keep HDD records can be found on page 4.

Use the family car efficiently[1]

To do this project, you will need to enlist the help of all the members of your family who drive. Make a chart for each driver and keep a record of every trip for a week. Record the purpose and mileage of each trip. The charts might look something like this:

When the week is over, study the number of trips, their purpose, and the total miles (kilometers) driven. Develop a plan with your family that will reduce the number of trips and the miles (kilometers) driven. Get each driver to agree to the plan.

Have each driver record all trips for one week, following your plan. Total the number of trips and miles (kilometers) driven. Now compare this with the previous week. How many miles (kilometers) and trips were saved? If your car averages 13 miles per gallon, how much gasoline did your plan save in one week? How much money? How much would it save in a year? (In the metric system, gasoline consumption may be given in liters per 100 kilometers.)


DRIVER #1
DATE PURPOSE MILES
SEPT. 4 TO WORK & BACK 14
SEPT. 5 TO WORK & BACK 14
SEPT. 6 TO WORK & BACK 14
SEPT. 7 TO WORK & BACK 14
DRIVER #2
DATE PURPOSE MILES
SEPT. 4 GROCERY 4
SEPT. 5 BASEBALL PRACTICE 3
SEPT. 6 GAS STATION 4
SEPT. 7 MUSIC LESSON 6
DRIVER #3
DATE PURPOSE MILES
SEPT. 4 MOVIES 6
SEPT. 5 4-H CLUB 5
SEPT. 6 NONE 0
SEPT. 7 GROCERY 4

1. Source: Federal Energy Administration

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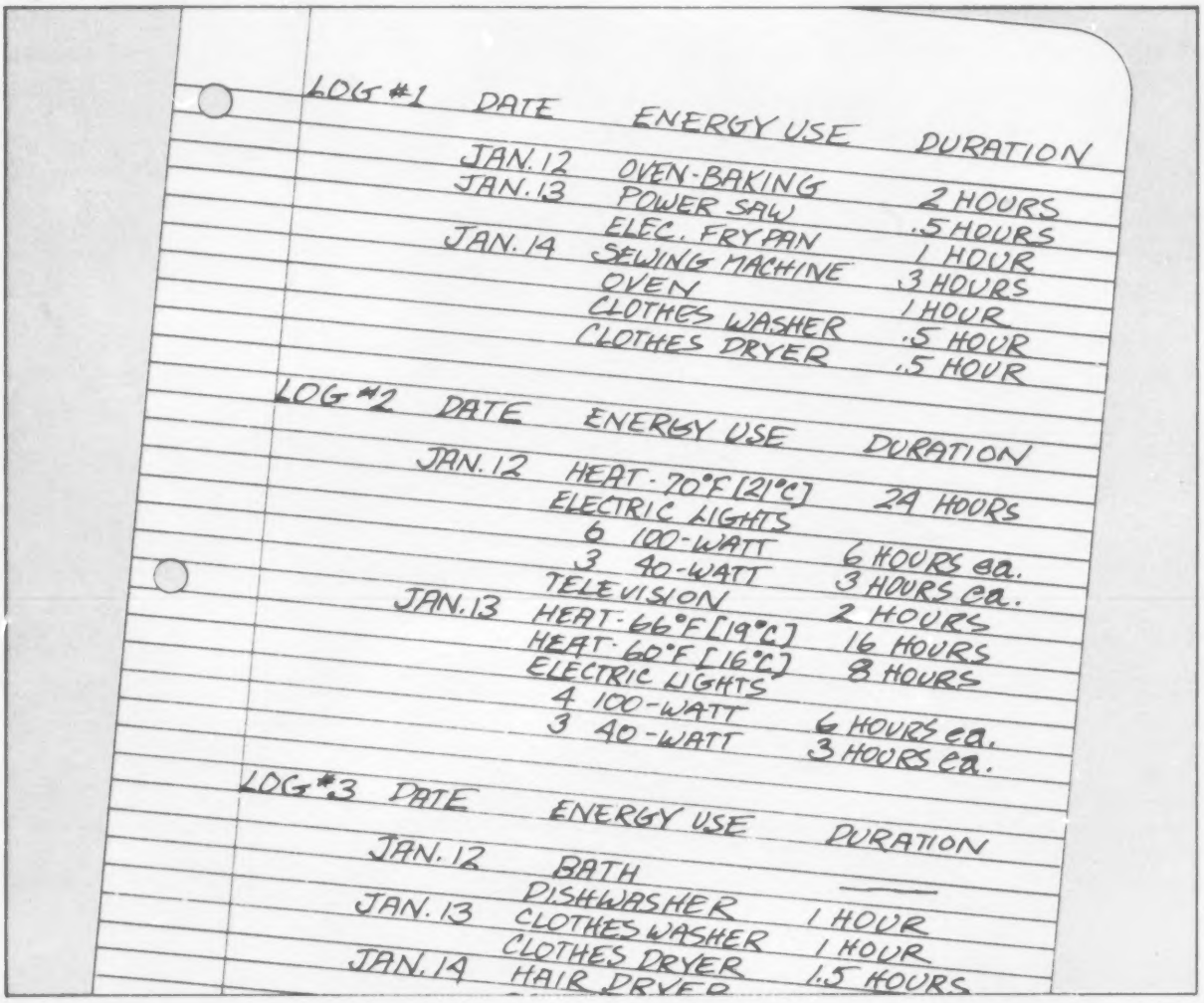
Read your electric and gas meters

Electric meters measure the amount of electricity used. The measurement is kilowatt-hours. (1 kilowatt = 1000 watts.) This is the amount of electricity needed to burn ten 100-watt light bulbs for 1 hour (10 bulbs × 100 watts × 1 hour). Most electric meters have a set of dials which are read in multiples of 10. The dial on the far right indicates tens of kilowatt-hours; the next one, hundreds of kilowatt-hours; the next dial, thousands of kilowatt-hours, and so on. Reading the dials can be tricky because some of the dials read clockwise, others counterclockwise. When the pointer is between 2 numbers, take the lower number.

The dials on a gas meter are organized much the same way as on an electric meter. The smallest quantity of gas measured by most gas meters is 100 cubic feet (3 cubic meters). The rightmost dial represents 100 cubic feet; therefore, the needle on the rightmost dial goes around once for every 1000 cubic feet (30 cubic meters) of gas used.

As in the previous test, you will need the assistance of all members of your family. Ask each person to keep a daily log of his or her use of energy. Assign one person the task of keeping track of the number and the length of time electric lights are on and the thermostat setting. The logs might look like this:



LOG #1

DATE	ENERGY USE	DURATION
JAN. 12	OVEN-BAKING	2 HOURS
JAN. 13	POWER SAW	.5 HOURS
	ELEC. FRYPAN	1 HOUR
JAN. 14	SEWING MACHINE	.3 HOURS
	OVEN	1 HOUR
	CLOTHES WASHER	.5 HOUR
	CLOTHES DRYER	.5 HOUR

LOG #2

DATE	ENERGY USE	DURATION
JAN. 12	HEAT - 70°F [21°C]	24 HOURS
	ELECTRIC LIGHTS	
	6 100-WATT	6 HOURS ea.
	3 40-WATT	3 HOURS ea.
	TELEVISION	2 HOURS
JAN. 13	HEAT - 66°F [19°C]	16 HOURS
	HEAT - 60°F [16°C]	8 HOURS
	ELECTRIC LIGHTS	
	4 100-WATT	6 HOURS ea.
	3 40-WATT	3 HOURS ea.

LOG #3

DATE	ENERGY USE	DURATION
JAN. 12	BATH	
	DISHWASHER	1 HOUR
JAN. 13	CLOTHES WASHER	1 HOUR
	CLOTHES DRYER	1.5 HOURS
JAN. 14	HAIR DRYER	

Read the electric and (or) gas meter as you begin your test. Read it at the same time the next day. Subtract the first day's figure from the second day's figure to determine how much energy was used in the 24-hour period. Each day during your test, read the meter and subtract the previous day's meter reading from the current reading. It is important, for test purposes, to read the meter(s) at the same time each day.

At the end of a week, go over the logs with family members and compare energy use with your meter readings. Can you see "peaks" (high energy usage) and "valleys" (low energy usage)? Can you identify the causes of the peaks?

Continue the logs and meter readings for a second week, but during that time get family members to agree to make serious efforts to conserve energy. Here are some suggestions:

- **Take showers instead of baths.**
- **Run the dishwasher once a day and air-dry the dishes instead of using the electric drying cycle.**
- **Use the clothes washer and dryer for only full loads. Use only cold water for rinse cycles.**
- **Dry clothes outdoors (if weather permits).**
- **Set the thermostat at 65°–68°F (18°–20°C) during the day; turn it back to 60°F (16°C) at night.**
- **Turn off all home entertainment equipment when no one is listening or watching and turn off all unnecessary lights.**
- **Use small appliances, when appropriate, for cooking.**

You'll probably come up with more ideas. At the end of the second week compare logs and meter readings again. Has there been an improvement? Encourage family members to read this manual to learn about other ways to conserve energy. Then continue to work together on the road to energy efficiency.

If you discover other ways to save energy in your home, you can let the writers of this manual know about them by addressing letters to:

Energy Task Force
Riley-Robb Hall
Cornell University
Ithaca, New York 14853

Good luck energy miser. And thank you!

ENERGY MANAGEMENT CHECKLIST

Have done	Will do	
		Temperature control
☐	☐	Reduce daytime home heating in winter, maintaining 65°F (18°C) or lower temperature.
☐	☐	Set air-conditioning unit to recirculate cool air instead of pulling in warmer outside air.
☐	☐	Increase temperature setting for summer air conditioning to 78°F (26°C) or higher.
☐	☐	Reduce nighttime winter temperature 5°–8°F (3°–5°C) or more.
☐	☐	Use window and attic fans for cooling during summer when outside temperature is below temperature in home.
☐	☐	Maintain heating and cooling equipment in good operating condition.
☐	☐	Keep air filters clean to make it easier for heating and cooling system to do its job.
☐	☐	Close off unused rooms and closets.
☐	☐	Use kitchen and bathroom exhaust fans only when necessary.
☐	☐	Install an exhaust fan in the attic to remove hot air in the summer.
☐	☐	Shade windows from direct sun in summer with draperies and roll-up shades.
☐	☐	Open draperies and raise shades to receive sun's heat in winter.
☐	☐	Close door of attached garage in winter.
☐	☐	Close damper when fireplace is not in use.
☐	☐	Select an energy efficient air-conditioning unit the proper size for space to be cooled. It is better to buy a slightly undersized unit, rather than an oversized one.

Have done	Will do	
☐	☐	Repair leaks and insulate heating and cooling ducts in spaces not heated or cooled.
☐	☐	Adjust radiator valves, air duct dampers, or heat registers according to activity in area.
☐	☐	Reduce heating and cooling temperatures when away from home for long periods of time.
		Insulation reduces heat loss or heat gain, improves comfort, and reduces energy required for heating and cooling.
☐	☐	Ceiling — minimum R-Value of 19.
☐	☐	Walls — minimum R-Value of 11.
☐	☐	Crawl space or unheated basement — minimum R-Value of 13.
		Window and door protection for winter
☐	☐	Install storm windows and storm doors, or
☐	☐	Cover windows and doors with plastic.
		Protect home from cold winter wind.
☐	☐	Plant or build a windbreak landscape treatment.
☐	☐	Use garage entrance where possible.
☐	☐	Protect entrances with double-door arrangement.

Have done	Will do	
		Seal air leaks.
☐	☐	Weather-strip doors, windows, and all movable joints.
☐	☐	Caulk interior and exterior cracks.
☐	☐	Seal unused doors.
☐	☐	Cap **unused** flues and (or) chimneys.
		Protect home from summer sun.
☐	☐	Plant deciduous trees.
☐	☐	Install a roof overhang to protect windows.
☐	☐	Use awnings or other treatment.
		Utilize breezes for cooling during warm season.
☐	☐	Close windows during midday.
☐	☐	Open windows in evening.
		Lighting
☐	☐	Turn off unnecessary lights, indoors and out.
☐	☐	Reduce lighting levels to minimum for task to be performed.
☐	☐	Use bulbs with lower wattage in halls, stairways, and other areas of general illumination.
☐	☐	Use light colors in decorating to improve lighting efficiency.
☐	☐	Do tasks that require a high light level during daylight hours when possible.
☐	☐	Keep lighting fixtures clean.
☐	☐	Use fluorescent lighting for maximum light from electrical energy used.
☐	☐	Use timers to turn lights on in the evening rather than leaving lights on all day when no one is home.

Have done	Will do	
		Food preparation
☐	☐	Use oven to capacity.
☐	☐	Use cooking utensils that fit surface unit.
☐	☐	Use tight-fitting lids on cooking utensils, when appropriate.
☐	☐	Reduce heat to maintain necessary cooking temperature when using surface units.
☐	☐	Use small appliances for cooking if they are more efficient than a range.
☐	☐	Preheat oven only for leavened foods. Do not preheat longer than needed to attain required temperature.
☐	☐	Turn off oven and surface units when food is cooked.
		Food preservation: refrigerator, freezer
☐	☐	Avoid opening door or holding it open unnecessarily.
☐	☐	Keep grilles and evaporator coils clean.
☐	☐	Locate cooling appliances away from heat sources such as range, hot air register, or direct sunlight.
☐	☐	Defrost as needed.
☐	☐	If cold air is leaking around door, have door adjusted or gasket replaced.
☐	☐	Turn off, empty, clean, and leave refrigerator door open when taking an extended vacation.
		Dishwashing
☐	☐	Accumulate dishes; hold until dishwasher is filled. If dishes are hand washed, rinse and hold breakfast and lunch dishes until evening.
☐	☐	Do not let hot water run continuously while washing or rinsing dishes.
☐	☐	Omit dishwasher drying cycle; open the door at end of the rinse cycle.

Have done	Will do	
		Heating water
☐	☐	Reduce amount of hot water used.
☐	☐	Insulate long hot water pipes, especially those under the home or those that go through unheated basements or crawl spaces.
☐	☐	Repair leaky faucets.
☐	☐	Maintain regular temperature setting of 110°–120°F (43°–49°C) on water heater if automatic dishwasher is not used, 140°F (60°C) if automatic dishwasher is used.
		Laundry
☐	☐	Wash only full loads of laundry.
☐	☐	Use heated water in only the wash cycle.
☐	☐	Use water no hotter than necessary for adequate soil removal and sanitation.
☐	☐	Use good laundry techniques to obtain satisfactory results in one washing process.
☐	☐	Avoid overdrying in clothes dryer.
☐	☐	Sort dryer loads by weight.
☐	☐	Line-dry garments and household items when practical.
☐	☐	Use dryer efficiently. Avoid drying one or two items at one time.
☐	☐	Vent electric dryer indoors during heating season.
☐	☐	Remove items when dryer stops to avoid unnecessary wrinkling, which will require ironing to remove.
☐	☐	Reduce ironing to a minimum by careful selection of garments and household linens.
		Cleaning and maintenance
☐	☐	Empty or replace vacuum cleaner bag frequently to keep it functioning efficiently.
☐	☐	Use hand equipment rather than power tools when practical.
☐	☐	Develop preventive maintenance practices. Routine check-up and servicing will prevent greater problems later.

Have done	Will do	
		Personal care
☐	☐	Minimize hot water used in bathing. Check to see if less water is used in showering than in tub bathing.
☐	☐	Add a flow restrictor to shower head.
☐	☐	Do not leave water running while shaving or brushing teeth.
		Recreation and Entertainment
☐	☐	Turn off home entertainment equipment when no one is really watching or listening.
☐	☐	Disconnect or use vacation setting on an instant-on television when you are not going to be using it regularly.
☐	☐	Use shop or hobby equipment efficiently.
☐	☐	Maintain tools in good operating condition.
☐	☐	Encourage family members to develop leisure activities that have low energy costs, such as bicycling, hiking, reading, and swimming.
☐	☐	Spend vacations closer to home.
☐	☐	Encourage home and neighborhood activities.
		Family Automobile
☐	☐	Drive at a moderate speed.
☐	☐	Drive smoothly with gradual starts and stops.
☐	☐	Drive slowly for first mile instead of letting car warm up by idling.
☐	☐	Provide proper maintenance; make sure you have well-tuned engine and properly inflated tires.
☐	☐	Combine errands by careful planning.
☐	☐	Carpool whenever possible.
		Other transportation
☐	☐	Walk, ride a bicycle, or use public transportation whenever possible.
☐	☐	Travel only when necessary.

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